

XXIII.—*Progress of the British North American Exploring Expedition.* Under the command of Capt. JOHN PALLISER, F.R.G.S.*

Communicated by the Right Hon. Sir EDWARD BULWER LYTTON, M.P., H.M.'s Secretary of State for the Colonies.

No. 1.

Read, February 14, 1859.

Fort Garry, Red River, May 3, 1858.

SIR,—I have the honour to report my arrival at this post, on my way to join the Expedition, and recommence my explorations this year from Fort Carlton.

I shall still be obliged to wait for some days until the grass is sufficiently forward to enable me to proceed on horseback.

Although the snow has disappeared, yet, owing to the cold northerly winds that now prevail, the grass is still quite as backward as it usually is at this period of the year, although the winter has been an extraordinarily mild one; I hope, however, that I may be able to start on or about the 10th instant.

I accomplished my voyage from Crow Wing, in Minnesota territory, to this place in a month, in a canoe, assisted by two half-breeds. We punted up the Crow Wing and Leaf Rivers, carried the canoe across the height of land from Leaf Lake to Ottetail Lake, but in attempting to cross the latter to the south shore we narrowly escaped being crushed in the ice; however, we extricated ourselves, and were consequently obliged to extend our portage along the eastern shore, round to the mouth of Ottetail River, the principal head of Red River. Down this river we ran all the rapids but one, making there quarter mile portage, joined the main stream of Red River at "Bois des Sioux," and came down to Fort Garry.

I have the honour to enclose you Lieutenant Blakiston's letter on the subject of the Hudson Bay and York Factory voyage up to Carlton on the Saskatchewan; likewise Dr. Hector's Geological Report of 1857, which I will thank you to be so kind as to place in the hands of Sir Roderick Murchison.

I shall forward Mons. Bourgeau's Report on the botany and flora of the country, with a request to have it placed in the hands of Sir William Hooker.

I have likewise received the map of the country, copied out by Lieut. Blakiston from the detached charts we ourselves made on the route. Unfortunately he made but one copy, and as I have not the means here of making a copy for myself, I will likewise defer forwarding it until after my arrival at Carlton.

* See 'Proceedings' Royal Geographical Society, vol. ii., pp. 38 and 146; also vol. iii., p. 122.—ED.

I have the honour of forwarding the Astronomical Observations enclosed in a letter from my Secretary, Mr. Sullivan.

I have, &c.,

JOHN PALLISER, Captain,

Commanding N.W. American Exploring Expedition.

*Her Majesty's Secretary of State
for the Colonies.*

First General Report on the Geology of the Country examined by the Expedition during the Season of 1857.

THE journey made by the Expedition during the first season has embraced two very different methods of travelling, marking regions of distinct geological structure and physical appearance. The first of these is the canoe route from Lake Superior to Lake Winnipeg; the second, the journey across the plains from Fort Garry to Fort Carlton.

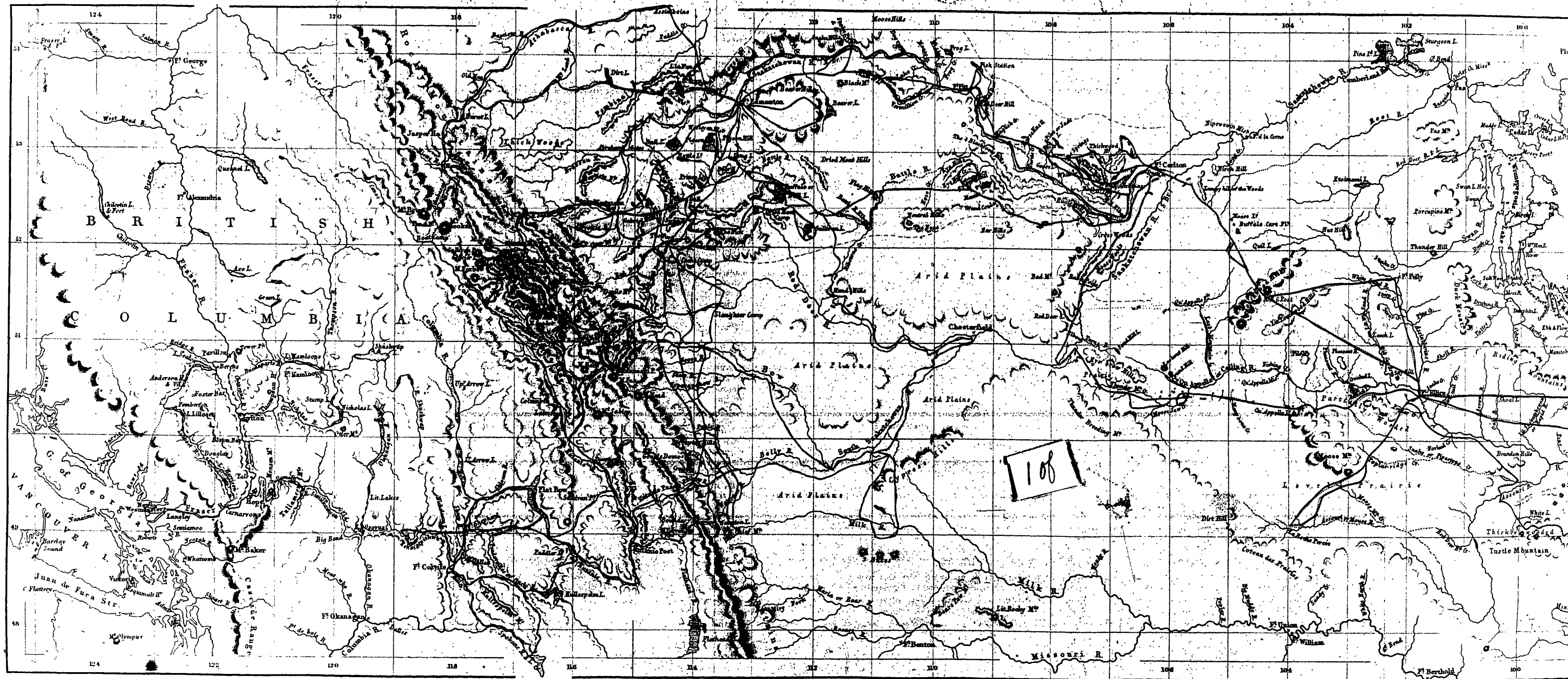
The general structural features of the country travelled over on the canoe route, so far as they can be learned from a single line of traverse, have already been well described by Mr. Keating, Sir John Richardson, Dr. Bigsby, and others; but from the complicated relations of the rocks of which it is composed, no detailed observations can be of any value until they are extended in every direction by means of an elaborate topographical and geological survey.

The whole of this district is occupied by a primitive axis, the intermediate primitive belt of Sir J. Richardson, which is composed of gneiss, mica schist, and other metamorphic rocks, with intrusions and outbursts of granite, probably of very different ages. From observations made in the course of our journey, it appears that there are two distinct directions of strata in the rock which compose this axis, marking it into two districts, one from Lake Superior to Rainy Lake, the other from Lake of the Woods to Lake Winnipeg. Not only the general strike of the altered and upheaved rocks in these two districts, but also the direction in which the water courses affect the principal descents, and the manner in which the lakes in each of them are arranged, all indicate a different direction of the elevating and disturbing force, in other words, two different axes.

These seem to converge towards the south, including an angle of about 25° , the eastern one being directed from the north-east to south-west, while the western one lies much more nearly north and south. In each of these there is a great central district, where nothing but rounded bosses of granite are seen occurring as ridges and islands, which rise little above the level of the flooded country in which they occur. On either side of these two granite districts metamorphic rocks are ranged, with great seeming irregularity as regards their order and dip, but still on the whole preserving their direction very consistently with the bearing of either of the two axes to which they belong. There are besides many minor outbursts of granite as dykes and intrusions, but they do not seem to interfere with the above-mentioned general bearings of the country.

In the district between Lake Superior and Rainy Lake the summit level is reached by an abrupt and rapid ascent in a direction at nearly right angles to the main eastern axis. Then follows a long traverse, almost along the summit of that axis, and then an abrupt but comparatively short descent to Rainy Lake again at right angles to the axis.

The first great step in the ascent from the east is made at the Kakabica

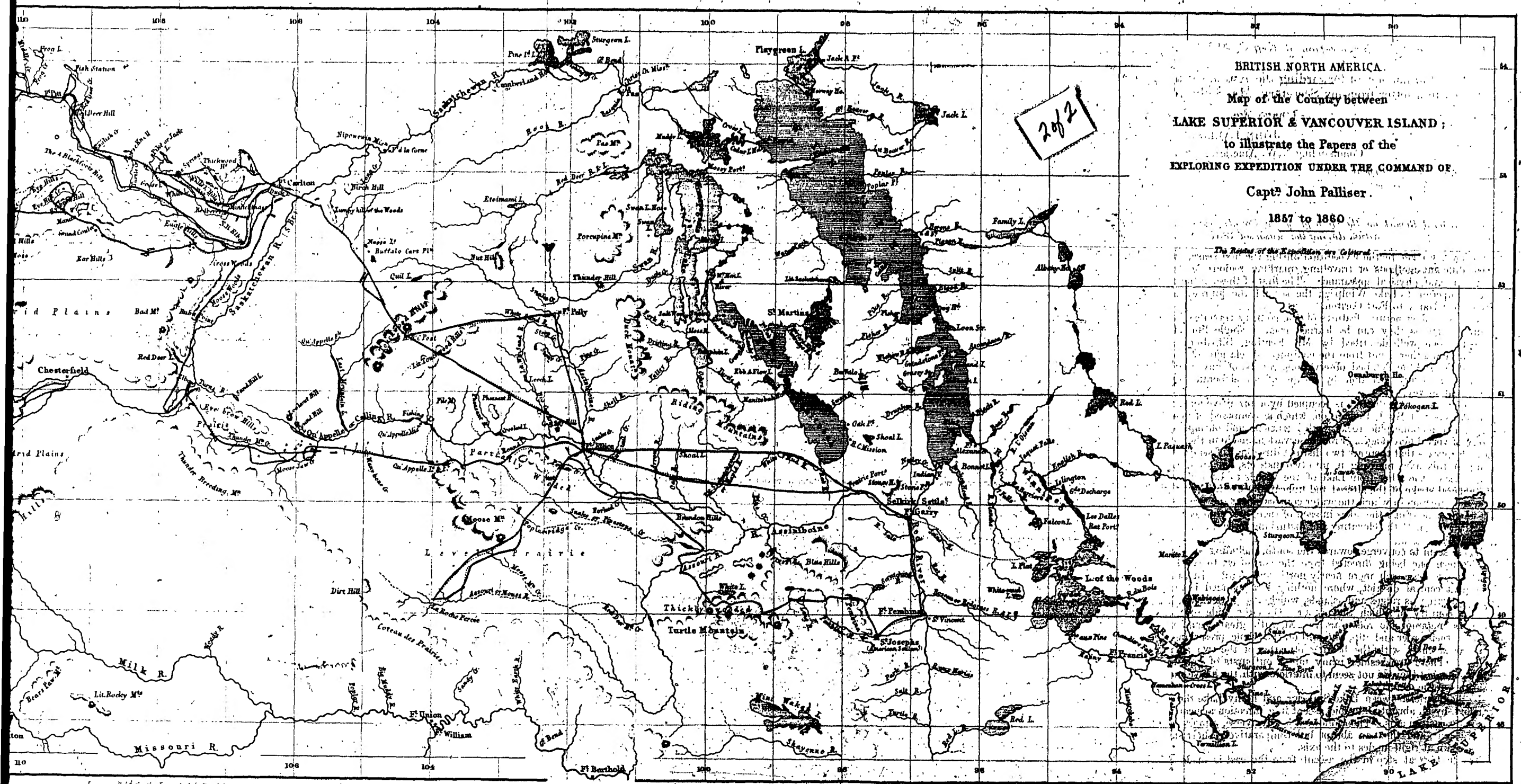


BRITISH NORTH AMERICA.
 Map of the Country between
 LAKE SUPERIOR & VANCOUVER ISLAND;
 to illustrate the Papers of the
 EXPLORING EXPEDITION UNDER THE COMMAND OF
 Capt^d John Palliser.

1857 to 1860

The Routes of the Expedition are Coloured.

2 of 2



Falls, where, from a succession of faults which mark the commencement of the more highly metamorphosed rocks, a sudden elevation is effected, the summit level of which is 179 feet above Lake Superior at Fort William.

About one mile below the fall a fine section is exposed in the form of a cliff 130 feet high, crossing the country from north-east to south-west, consisting of a dark argillaceous schist in thin fissile beds from one to two inches in thickness, very much jointed, and having many small veins of quartz, and sometimes calc spar, included both in the lines of bedding and in the joints. These beds are quite horizontal, and through their whole thickness the river has cut its way back to the present position of the fall in a manner similar to that in which the river-bed below the Niagara Falls has been formed. At Lazy Portage, and at various points in the River Kaministiquia below the fall, and also at several of the rapids in the lower part of the White Fish River, small sections of the same beds were seen, but all dipping to south-south-east at 30° . But on ascending the latter river to a point south-west from the Kakabica Falls, there a section is exposed of the same strata, horizontal, like these at the fall, but only five feet high. Again, on the River Kaministiquia, above the fall at Friar's Portage, the strata have acquired an almost vertical position, and a little farther on, at Lower Island Portage, are found to be dipping at an angle of 40° to south-south-east, and to have become changed in character, having mica developed in them, and also greater abundance of quartz veins than before. Immediately afterwards in the course of the ascent true granite occurs, and after several alternations, the schistose flags reappear at Upper Island Portage, but now dipping at a high angle to the north-west.

From the Falls to the Dog Lake the ascent of the river pursues a northerly course, crossing the beds obliquely by a succession of minor falls, giving rise to scenery of unequalled beauty. At the Dog Portage another sudden rise takes place in the water level, for the rocky high grounds, which for a long way below have been skirting the river at some distance, forming as it were the limits of a wide valley, here converge and form a granite barrier across the river, the summit of which is about 719 feet above Lake Superior, and 440 feet above the river at the lower end of the portage, but only 140 feet above the lake level at the upper end, thus making a rise in the water level of 297 feet in the short distance two and a half miles. As the portage road passes right over the top of this hill, and leads to a point on the lake far from the exit of the river, the nature of the falls which produce this sudden change in level could not be examined, but the mass of the hills seem to be granite. Although this is not the highest point of land over which we passed during the route, still it is probable that this hill is as high as any portion of the rocky axis of the country, as those along the lake are even inferior to it in elevation, while the ascent which is made after leaving the upper end of Dog Lake is through a swampy country covered with drift. In fact, after leaving Dog Lake until a considerable descent has been made to the west, no rock is exposed, the whole summit level being covered with a thick deposit of drift, as will be afterwards described.

From the Lake of the Thousand Isles, where the rocky flooring of the country is again uncovered, until Sturgeon Lake is reached, the descent is very slight; and by referring to the map (Sheet 1) it would be seen that the route follows a chain of small lakes, which are in most cases detached from one another, being separated by rocky barriers, over which the canoes and cargoes are carried. In many cases the lakes are at exactly the same level at each end of the portage, and the greatest difference between the two ends of any of these portages is only about thirty-five feet, so that the total descent in this part of the route cannot amount to very much. This chain of lakes may, in fact, be considered as occupying a line parallel with the summit of the water-

shed, and the country in which they lie is almost wholly composed of granite, occurring in broad rounded eminences, nowhere rising to 100 feet above the level of this half-drowned country. It is probable that this granitic belt is expanded considerably where the Old Portage route crosses it, and that the whole chain of lakes between Lake Kasiganagah and Sturgeon Lake lies within it. It is this belt which will form the great obstacle to the formation of any kind of road across this watershed.

From Sturgeon Lake in Bad River there is a considerable descent to the south, which forms the only exception to the general north-westerly descent of the waters to Rainy Lake.

From the Lake of the Cross to Lake Namucan the descent is rapid, and the river channel crosses the strata of gneiss and bedded greenstones at right angles, following a direction of the dip.

Rainy Lake has its length agreeing with the strike of the strata, which is here more nearly east and west than before.

Between Rainy Lake and the Lake of the Woods the superficial deposits again cover all rocks from view, and when the north end of the latter lake is reached, and they are again exposed, their general strike is now changed to almost north and south, agreeing with the greater axis of the lake, just as Rainy Lake agrees with the strike of the eastern district. The descent from the Lake of the Woods to Lake Winnipeg is by successive groups of falls, between which the river forms lake-like expansions, which lie generally at right angles to its main course.

The first part of the river Winnipeg flows across vertical strata, and then enters a granitic district very similar to that passed through between the Lake of the Thousand Isles and Sturgeon Lake.

The exact western limit of the axis at Lake Winnipeg was not seen, but the quantity of loose unworn fragments of lower Silurian limestone scattered about on the banks of the river and on the shore of Lake Winnipeg indicate the immediate neighbourhood of these strata. At the Seven Falls a large ortho-ceratite was found among the shingle on the river margin.

The distribution of the drift on this axis is very interesting. On the east side for a considerable way above the Kakabica Falls the country is covered with an alluvial deposit of red marl earth. Along the Kaministiquia this forms the high terraced banks of the river; for instance, opposite the mouth of the White Fish River, there are three of these terraced levels at the elevations above the river of 20, 60, and 90 feet. There are scarcely any boulders in this deposit, and when any are seen they are in spots from which this alluvial deposit has been removed and the underlying rock surface exposed.

On the summit level there is a great deposit of drift, consisting of coarse red sand with many boulders large and small. This deposit forms a flat swampy plain level, and well wooded towards the west, but towards its eastern margin, as at Cold Water Lake, worn into deep dry gullies and round pot-holes or conical depressions without any axis. The thickness of this deposit must be about 200 feet. The highest level of it measured was 8·3 feet above Lake Superior.

The banks of the lower part of Rainy River are composed of a rich alluvial deposit of a light grey colour, containing a large proportion of white sand. It is distinctly stratified in some parts, and is only elevated about ten feet above the river level; no boulders occur in it. As a very slight rise in the level of the Lake of the Woods or a depression of Rainy Lake would suffice to connect these two lakes along the course of this river, it is not improbable that this deposit has been formed in such an extension of the former lake. But the upper part of the same river has the banks high and terraced, and boulders are plentiful, showing that at this level there is also a deposit of true drift.

Below the Seven Portages on the Winnipeg River there again the river flows

through a smooth channel, and the banks are composed of a deposit of soft white marl earth, the river being at first only slightly depressed, but soon from its rapid descent the banks become high as the level of the deposit remains the same. At Rat Portage, however, it retires from the river on either side, and below the falls at that place is replaced by another on another level through a cutting in which the river runs to its mouth at Fort Alexander. The banks of the lower part of the river are very distinctly terraced.

The estimated levels of the drift deposit at Rainy River, the Seven Portages, and at Rat Portage, are respectively 460, 350, and 270 feet above Lake Superior, and deducting 195 feet from each, as the probable elevation of Lake Winnipeg above that lake, we have the levels above it at 265, 155, and 75 feet.

Glacial scratching was very distinctly seen at many points on the route. The direction is almost always north and south. Hardly a surface in the two granitic tracts did not present distinct scratchings. They were seldom to be seen; however, on the southern exposure of rock surfaces, if these sloped much; but the more a surface with a northern exposure sloped, the better they seemed to be marked.

A map has been prepared of the country traversed by the expedition between Fort Garry and Fort Carlton, on which the results obtained have been as far as possible laid down.

The country around Fort Garry is a level plain of drift, which consists of a light-coloured marly loam rather deficient in sand, with beds of white tenacious clay. Only a few boulders are to be seen scattered over the surface of this plain, generally angular fragments of the Fort Garry limestone of large size. At the Settlement the river is sunk from 40 to 70 feet below the level of this plain, but nearer its mouth it flows through a level swampy country, elevated only a few feet above its surface. At the Lower Fort, 18 miles below Fort Garry, which latter is situated at the junction of the Assiniboine with Red River, there is a section of magnesian limestone exposed in the bed of the stream when the water is low, and which is then quarried for building purposes. As the river was high when we were there, this section was not visible; but from among the fragments lying on the bank several fossils were obtained, such as *Favosites*, *Septaria*, &c., and some poor specimens of *Receptaculites*. Major Seaton, the officer in command of the troops stationed at the Upper Fort, kindly offered to make as complete a collection as he could when the state of the river allows of the beds being examined, and when the search will be facilitated by the labours of the quarrymen. This limestone is of a light buff colour with purple blotches, very hard and with a sharp angular fracture. At Stony Hill, about 15 miles north-west from the Upper Fort, there is an isolated bluff of limestone, rising from the plain level to the height of 80 feet. The south and western exposures are abrupt and water-worn, it having evidently been at one time an island; and, indeed, during the great floods which have several times inundated the Settlement, it has been one of the few spots upon which the inhabitants can take refuge, reaching it by means of boats. The beds of limestone are horizontal, or nearly so, and are slightly different from those at Fort Garry in their mineral aspect, having a more crystalline fracture and the colour being of a reddish hue. No fossils can be discovered in newly-fractured portions, but on the weathered surfaces a few obscure remains of fossils are to be seen projecting along with siliceous and gritty particles from a dull floury surface.

After leaving Red River, along the whole route to Fort Carlton, at only five localities were any of the strata observed which must underlie the drift throughout this vast extent of country. At Long River, lat. $49^{\circ} 8' N.$, long. $98^{\circ} 35' W.$, a tributary of Pembina River flowing northwards, and again at Forked Creek, a deep gully that joins the valley of the Assiniboine in lat. $50^{\circ} 6' N.$, long. $101^{\circ} 18' W.$, sections were observed of a compact shale, of a

light greenish drab colour, not occurring in continuous layers, but as fragments with irregular conchoidal surfaces which have been produced by the desiccation of what was originally thin continuous beds of clay. Sometimes it makes a nearer approach to a slaty character. Among these beds are bands and nodules of a hard deep brown-coloured clay iron-stone, and perpendicular fissures are common, which are filled up with splintery iron shale. A careful examination of these beds at Long River did not afford any fossils, and a long search of those at Forked Creek only yielded six or seven very minute specimens, among which were scales of fishes (ctenoids?), a small bivalve, and several obscure impressions. Throughout these shales there occurred ochrey calcareous tubes, about half a line in diameter, traversing the layers perpendicularly. At both these places the thickness of the strata exposed amounts to about 30 feet. At Long River they dip to the south, but not with regularity. At Forked Creek the strata are strictly horizontal, and were seen in two creeks two miles apart, having exactly the same characters. No clue could be discovered to their relations with other rocks, as the sections only occurred in deep bends in the creeks, for all else was obscured by drift. At Long River they were covered by about 6 feet of pure white sand, very incoherent, and over this lay the ordinary drift, consisting of light grey calcareous earth. At Forked Creek they were overlaid by about 20 feet of drift.

At Fort Ellice the banks of the Assiniboine are 200 feet high; and at one point there, a recent slide having taken place, a partial section of the bank was displayed. The upper part of this section consisted principally of comminuted fragments of the same *Long River shale*, with local beds of pure sand, also the more common grey drift.

At a part of this slide which was cut by a bend of the river, strata of tenacious calcareous clay were visible, of a dark purple black colour, but with the weathered surface decomposing into a red ferruginous earth. Along with these clay strata were two beds of soft clay ironstone, about four feet apart, the lower one half a foot thick, and rather compact, the upper one concretionary, forming thick nodulated masses, the upper surfaces of which were calcareous, and very like decomposed coral.

At the elbow of the south branch of the river Saskatchewan, at the point where it meets the great Prairie ridge, known farther south as the "Coteau des Prairies," similar clay beds were seen, having the ironstone concretions occurring in great profusion, and in several of these were found fragments of chalk fossils, inoceramus, baculites, and others. As the mineral resemblance to those beds at Fort Ellice is perfect, there can be no doubt as to their similarity in age. At the elbow the section is one of great interest, from the relation of these beds to the drift by which they are covered. Sheet 4 is a sketch map of the river a little above the elbow, with a section exhibiting the manner in which the beds occur. In the section, the pale blue colour represents the soft clay strata, which are almost horizontal, while the ochre tint represents the drift. This latter thins out as it nears the "Coteau," which is probably mainly composed of the clay strata, with only a thin covering of drift on its eastern aspect. As this part of the river was the western limit of our journey this year, this point could not be determined. Seeing that the under surface of the drift lies unconformably with these soft clay strata, it is evident that the eroding agency has had its western limit here, the cause of which was certainly not the hardness of the beds that it encountered. Portions of these soft strata have been formed by the action of the river into conical mounds, which present a most extraordinary appearance. As no grass has time to grow on them, from the constant attrition of their surface, they are perfectly black, and their outline is broken into terraces by the successive lines of ironstone concretions, which, from their hardness, retain the soft strata underneath them. There is a large quantity of gypsum disseminated throughout

these beds, occurring as transparent selenite crystals in radiating groups. There are no large beds or masses of it.

From Fort Ellice a trip was made for a few days' journey to the south-west, in consequence of the reports by the Indians of wonderful stones that occur on the banks of the Assouri River. The place is called by the half-bred hunters *La Roche Percée*. The route followed to this place passed by the eastern end of Moose Mount, which will be described afterwards in connexion with the drift, and of which it seems to be entirely composed. The ascent to the base of this hill was about 400 feet above the Assineboine at Fort Ellice, and in continuing southwards until we struck the Assouri, a descent of about 100 feet was made. Thus the probable height of the plain through a cutting in which the Assouri runs in this place is 300 feet above the Assineboine, while the valley of the river is 165 feet deep, so that the difference of level between the two rivers amounts to about 135 feet.

The direction of the Assouri here is easterly, and Sheet 5 is a rough map of a portion of it, with a view of its north bank. The whole prairie here is covered with a most extraordinary profusion of boulders, which are fragments of granite, gneiss, limestone, &c. In the valley, a group of strata is exposed, a section of which is given in Sheet 6, as follows:—

	Feet.
a. Drift with boulders from	4 to 7
b. Mud-stone	1
c. Incoherent sandstone, fine grained, with hard concretions impregnated with iron, which weather concentrically	10
d. Porous calcareous scinter	1
e. Hard dark-blue ironstone shale, decomposing into deep orange-coloured splinters	2½
f. Gritty limestone	2
g. Ash-coloured clay in thin indistinct layers, very soft, with one bed of coal 9 inches in thickness	8
h. Hard blue limestone	3
i. Same as g, but with three beds of coal, 10, 8, and 6 inches in thickness	15
k. Gritty limestone	2
l. Brightly-coloured marls and shales, with selenite in small fragments	10
m. Very coarse-grained, incoherent sandstone, more than	20

No trace of fossil remains was found in any of these beds to indicate their age.

The coal does not occur as well-defined beds, but graduates into the shales on both surfaces. It is not visible until a light ashy deposit is removed from the exposed edge of the bed, produced by the soft clay washing down from the strata above. The coal is of several qualities, some having quite the appearance of compact cannel coal of fine quality, some like the more glistening bituminous coal, friable, and only to be obtained in small cuboidal fragments, while some can hardly be distinguished from charcoal. Where we crossed the Assouri, between Turtle Mount and Fort Ellice, fragments of similar coal were picked up in the bed of the stream, no doubt derived from these seams. Also at the elbow of the south branch of the Saskatchewan like fragments were found, so that we may expect to meet with similar beds in the course of our journey up that river during the next year. A rough analysis of an averaged specimen of this coal on a small scale gave the following results:—

Aqueous and volatile matter	40 per cent.
Carbon	50 "
Light orange-coloured ash	10 "

In the first of these groups there seems to be an unusual deficiency of tar and coal gas. It burns in the air with difficulty, without flame.

The sandstone which forms bed C. is composed of very fine pure grains of quartz, hardly cohering; but in the upper parts of the bed there occur concretions impregnated with iron and of a reddish hue, which are comparatively hard, and decompose concentrically. It is this irregular disintegration of this bed that gives rise to the curious appearances that have rendered this spot an object of great superstition among the Indians. The lower sandstone wears away from under the hard concretions, which, from their peculiar manner of weathering, assume the forms of compressed spheres, and sometimes long cylinders like the boilers of a steam-engine, and these are left elevated on pillars of the white sandstone. The gullies which join the main valley are thus peopled with grotesque forms, some exactly resembling the ruined nave of an ancient abbey, while those concretions which have just reached the surface, but have not yet become isolated by the disintegration of the bed below, may be taken for gigantic tombstones, and so further the illusion. The sandstone at the base of the section is also very incoherent, but composed of larger grains. The strata are not found in the same proportion and order in different parts of the valley, but they are always horizontal. The thickest bed of coal that was seen was one foot, but the ashy clays were at some places very much thicker than at others. The marly shales have quantities of gypsum embedded with them, but only in small detached crystals. In regard to their probable age the description of the upper beds of the cretaceous system given by M. Jules Marcou in the 75th page of his '*Revue Explicative d'une Carte Géologique de l'Amérique du Nord*' seems to be that of very similar beds to those seen here. The position of "Roche Percée" is lat. 49° 6' N., long. 103° 59' W.

The whole country traversed by the Expedition during the last year has been overspread by superficial deposits of great thickness. Although these might be all included under the group of Northern Drifts in the ordinary acceptation, still it is probable that they consist of deposits of very different ages and circumstances of deposition. Three boldly marked levels were observed of different mineral composition as well as geographical distribution. To the first of these belong the deposits of the wide flat plain upon which the Red River Settlement is situated; this forms the first prairie level. Its composition is marked by a preponderance of argillaceous marl and a deficiency of sandy matter, and it is invariably stratified in thin layers. Underlying this, at various depths from the surface, is a bed of stiff light-coloured clay, and which forms the immediate margin of the river in many points. The upper parts of the deposit contain leaves and fragments of wood and reeds, and the whole has quite the appearance of a fresh-water deposit, indicating a time when Lake Winnipeg covered a much more extensive area than it at present occupies.

The surface of this deposit must be from 75 to 100 feet above the lake, but it slopes from the west towards Red River, and at St. Joseph, where the second prairie level supervenes, it may be 100 feet higher. The first prairie level has a very irregular outline to the west. Pembina Mount at St. Joseph is formed by the eastern limit of the second prairie level at that place. It follows a northerly course as an abrupt terrace, varying from 200 to 300 feet above the first level for about 30 miles, when it turns to the north-west, and assumes at the same time a more gentle slope, up which our route lay. Sheet 8 is a rough reduction of the larger map, having the different levels exaggerated, so as to render them more distinct. Colours have been used to represent the probable range of these different levels.

The composition of the second great level is very different from that of the first. Sand is the preponderating ingredient. Thus at St. Joseph, where the banks of the river Pembina present a fine section of it, the material is coarse red sand with gravel and boulders, very similar to that observed on the eastern limit of the drift beds on the summit of the water-shed between Lakes

Superior and Winnipeg. There are no signs of stratification in any part of this deposit, as seen at Pembina Mount. Farther west, however, it assumes a light grey colour, and contains a considerable portion of lime. At Fort Ellice, as before mentioned, the upper portions of it consist entirely of fragments of the Long River shale. That the whole thickness of this level at every point is not formed of drift, is proved by the discovery of the shale beds at Long River and Forked Creek, forming as it were a nucleus to it. Notwithstanding that this level is everywhere cut to a great depth by rivers and creeks, very little can be learned of its nature at different points, as slides at the banks of the gullies are but rarely seen. The slide near Fort Ellice of the banks of the Assineboine has been spoken of in connexion with the beds, probably of cretaceous age, which are visible at the base of it. Another similar slide was seen at the Qu'Appelle Lakes, which are a succession of dilatations of the rivers of that name lying in the bottom of a deep wide valley cut through this second level. This slide did not expose the bank quite to the base, but as far as was visible, consisted of a stiff sandy clay, of a light red colour, with patches of blue clay and gravelly beds. In fact, the characters of this level, as far as regards its mineral composition, seem to be very variable and local. Boulders are tolerably plentiful all over it, but occur in greatest quantity upon the sides and summits of ridges and mounds, which are irregularly dispersed over this level, rising abruptly, and generally to the height of about 50 feet. A great deal of this level is clothed with clumps of poplars. There are, however, some large tracts of bare plain.

The third level is what is spoken of by the hunters as *La Grande Prairie*. The route of the Expedition did not traverse this level at all, its westerly course meeting it only at the elbow of the south branch of the Saskatchewan, at which place the approach of winter compelled us to turn northward. There are, however, two hills, or mountains, as they are termed by the hunters, viz., *Turtle Mount* and *Moose Mount*, which seem to be detached outliers of this level, their summits having nearly the same elevation as that of the summit of this level. These hills are very much alike, consisting of irregularly disposed ridges and cones of very coarse drift, highly charged with boulders. Some of these cones have very steep sides, and rise to the height of 300 feet from their base, and their summits are about 600 feet above the second prairie level. The northern aspect of these hills is very irregular, as also their central mass, being mostly densely wooded, and enclosing numerous small lakes; but their southern aspect is a long gentle slope utterly devoid of trees, and being continuous with the level prairies beyond, which reach as far as the true eastern limit of this level, the "*Coteau de Prairies*."

The Great Prairie ridge of the hunters has a direction from north-west to south-east, with its northerly aspect very much furrowed in the same manner as has been mentioned in reference to its two outliers, *Moose Mount* and *Turtle Mount*. At *Roche Percée* this ridge was about ten miles to the south, and the extraordinary profusion of boulders at that place, and the thin layer of drift which covered the coal-bearing strata, together with the facts which were observed with a similar proximity to the "*Coteau*" at the elbow of the Saskatchewan, all indicate that the drift has at the "*Coteau*" its south and westerly boundary.

JAMES HECTOR, M.D.

Fort Carlton, December 14, 1857.

Fort Carlton, Saskatchewan, June 7, 1858.

SIR,—During the latter half of last October I proceeded to Fort Pitt and obtained the horses which you had ordered at that place for the service of the Expedition. On my return I made observations for latitude and longitude at

various places on the route, and constructed a rough map of the country between Forts Pitt and Carlton.

I found on my arrival at this place, that Lieut. Blakiston was busily engaged making preparation for carrying on a system of magnetical and meteorological observations during the winter months. We commenced the observations on November 12, each member of the Expedition taking six hours' watch during the day and four during the night, in rotation. I continued on duty at the Fort until February 25, when a scarcity of provisions being felt, I proceeded to Pike Lake, where fish at least could be got. While I remained at the lake, which was from March 1 until April 2, I was employed chiefly in obtaining fish, and in that short time caught upwards of 100 jack fish, besides a few white fish.

There has been a great scarcity of provisions throughout the Saskatchewan district; the Indians have been reduced to eating their horses, and hunting wolves and foxes for food, as not a single buffalo has appeared for many miles on either side of the river, except at Edmonton, where they have been so thick as to defy the hunters running them.

On April 1, Dr. Hector, who according to your orders had been to Edmonton on business connected with the Expedition, arrived at Pike Lake on his way to Carlton; so I accompanied him to this place, where we arrived on April 7.

Throughout the winter, as previously, I have kept up regularly the journal of the Expedition, and although it is meagre in detail during the depth of winter, yet as the spring advanced I have been very careful to note everything characteristic of its advancement. In addition I have taken the temperature of the river daily from the breaking up of the ice till now, and noted either its increase or decrease of volume very carefully. I learn from Dr. Hector that he has a number of like observations which he took in the autumn before the ice formed on the river, so an interesting comparison may be instituted between the two sets of observations.

During our stay at Carlton I have made a complete series of observations for latitude and longitude, and frequently in the winter I have taken observations to ascertain how my chronometers behaved. Thirteen lunar distances are worked for the longitude of this place, and I have as many more yet to work.

In the many spare hours which I have had in common with the other gentlemen of the Expedition, I have collected a large number of insects and other animals and various shells, for the purpose of getting them forwarded to England. There is one squirrel in the collection which is undoubtedly new; it resembles the *Arctomys Hoodii*, but is much smaller, and is not patched with light hairs on the dark stripe as is that animal.

I have, &c.,

J. W. SULLIVAN,

Secretary to Expedition.

*Captain PALLISER, Commander of
North British American Exploring Expedition.*

Observations of the Temperature of Soil at various Depths, and the Depth of the Frozen Ground.

Fort Edmonton, 1858.

1. On the 22d February commenced digging a hole in the field behind the fort, on the top of the high bank on which the mill stands. In three days reached the depth of 4 feet 6 inches; ground still hard frozen. The digging was discontinued in consequence of the man being required for something else.

2. March 3d. The digging recommenced to-day, but as the ground must have frozen in the bottom of the old hole, a fresh one has been commenced 6 x 4 ft. in the same field, but on a level with the fort, at a distance of 12 yards

from the pickets. The soil is the same as that displayed in the last hole; dark loam for 9 inches, then a yellow reddish earth, enclosing fragments of the beds associated with the coal, also angular pieces of the coal itself, rounded fragments of gneiss, quartz, &c.

March 4th. The hole is now dug to the depth of 4 feet 10 inches, the last 3 feet through fine light red sand, which was so dry as almost to look like unfrozen earth: however, it got so much softer, and broke down so fine after it was extracted, that there is no doubt that it is still frozen. But besides, a bed has been reached of a white earthy clay, including fragments of coal, so hard frozen as to resist the pick and the borer, and which on being thawed softens completely.

This afternoon I bored a hole with the auger in the bottom of the dug hole, and intended to carry it down three feet, but the clay bed proved too hard for the auger to pierce; so after I got down three inches, I placed the thermometer in it, packed it round with soil, and then filled the large hole with a foot or two of hay to prevent the temperature of the atmosphere during the night from influencing it.

March 5th. Thermometer, at 5 feet, at 8 a.m., 30° ; surface, 20° .

The unfrozen soil was at length reached to-day, at the depth of 7 feet 6 inches, in a bed of sand with rounded stones, and the line of frozen soil was easily perceived. The hole is dug for 4 inches below it, and then 4 inches more were bored, and the thermometer placed in it at the depth from the surface of 8 feet 2 inches.

March 6th. Therm., at 8 a.m., 33° (at 8 ft. 2 in. from surface); surface, 38° .
" at noon 33° " 49° .

3. March 2d. In the field behind the fort, at a short distance from the pickets (20 feet), bored a hole one inch in diameter to depth of two feet, placed thermometer at bottom, having its bulb covered with tow, and being enveloped in a metallic case; then rammed in a plug of tow above it so as to prevent the air having any access to it. The following are the readings of thermometer:—

March 3d, at 8 a.m., $18^{\circ}\cdot5$; surface, 20° .
" at noon, $18^{\circ}\cdot5$ " 24° .
" 4 p.m. $18^{\circ}\cdot5$ " 24° .

4. March 3d. Increased the depth of hole to 3 feet, and adjusted the thermometer as in 3. Readings as follows:—

March 4, at 8 a.m., $21^{\circ}\cdot5$; surface 23° .
" at noon $21^{\circ}\cdot5$; " 30° .
" 4 p.m. water had filled it, from the melting of

the snow, and hot water had to be poured down to get thermometer out.

5. February 25th. After three days' thaw the surface of the field behind the fort is converted into a soft mud to the depth of three inches, and the ground is thawed to the depth of eight inches. This is on a slope where no water has lodged.

February 27th. The ground this morning is as hard frozen as ever again, the frost of twenty-four hours, having a minimum temperature of $0^{\circ}\cdot5$, having proved sufficient to re-solidify it to the full depth to which it had been softened.

JAMES HECTOR, M.D.

Fort Carlton, Hon. Hudson Bay Company,
Saskatchewan, June 8, 1858.

SIR,—In accordance with your instructions, that I should make every effort to engage twelve or fifteen men, and obtain at least fifteen horses, for the use of the Expedition during the next season, conveyed in your letter written from *Touchwood Hill Post*, and dated 16th October last, during the early part of the

winter I made every inquiry as to the facilities for carrying out your wishes. The result of this inquiry convinced me that it was necessary that I should make a winter journey, at least as far as Fort Edmonton, as it is only there that any half-breed population is to be found not under direct engagement to the Hudson Bay Company.

Accordingly having obtained dogs, and completed all other arrangements, I left Fort Carlton on the 14th of December.

Up to this time I had taken my share in the hourly observations which Lieutenant Blakiston was engaged in carrying on, and which commenced on the 12th of November; and previously to that time I made a six days' trip to the north-west for sixty miles, to examine the Thickwood Hills, which bound the Carlton Plains in that direction by an abrupt densely wooded terrace, about 500 feet in height.

From Fort Carlton to Fort Pitt, the next highest Company's post on the river, I found the distance to be 199 miles: the track I followed is about twenty miles longer than the usual one, but was preferred, as it is so much easier for the dogs to follow a track already beaten, than open a new one through the snow. We skirted a range of hills which forms a continuation of the Thickwood Hills to the west, and passed over many lakes, the principal of which are Redberry Lake, seven miles wide and ten miles long, and Jack Fish Lake, eight miles wide and twelve miles long. At the latter of these I found a small temporary post of the Company's, which was only in the course of erection. I heard here that the buffalo had been very numerous, but that they had all been passing to the south-west, and now none were to be seen but a few straggling bulls.

We reached Fort Pitt on our seventh day from Fort Carlton. It stands on the left bank of the Saskatchewan, at a point where it takes a bend to the north. Before reaching the latter place, however, it makes a great sweep to the south, passing along the base of the Eagle Hills, which I had observed as a blue line skirting the southern horizon.

Fort Pitt is in latitude $53^{\circ} 30' N.$, and longitude (Lefroy) $109^{\circ} 10' W.$

On the 24th of December, accompanied by Mr. Simpson, the gentleman in charge at Fort Pitt, I started for Edmonton House. With the exception of the first day's journey, our road lay along the south side of the river, so as to cut off a great bend which it makes to the north between the two places. The country now passed through was on a much higher level than that before reaching Fort Pitt, agreeing with the summit of the hilly ground which was then skirted, and from this level other hills again rose. The rise of the country to Edmonton, nevertheless, is very inconsiderable, when the distance is considered, hardly amounting to 1,000 feet.

For the first few days after leaving Fort Pitt, we found the plains covered with buffalo; and early one morning I was fortunately at a camp of Indians just as they had filled their pond with about 100 of them, and were carrying on an indiscriminate slaughter. The pond is an enclosure of stakes and branches of trees interwoven, having one broad entrance, which is so constructed that the buffalo, once driven in, cannot again escape. At almost every camp of Indians, of which nine were passed since leaving Carlton, I saw one or more of these ponds, and I believe the number of buffalo killed in this manner in each year throughout the Saskatchewan district is enormous. After the pond is filled they must of course slaughter every animal before they can remove any of the meat.

The country to the south of the river through which we passed is more generally wooded than it is reported to have been some twenty or thirty years ago, but the wood is all of a worthless character, consisting of small poplars, with only a few clumps of spruce in the swamps as Edmonton is approached.

On the 30th of December, our sixth day from Fort Pitt, we arrived at

Edmonton House. The distance I found to be 191 miles. The snow had been rather deeper than formerly, so as to render the rate of travelling slower.

Edmonton House, which is a large establishment, and the residence of the chief factor, who controls the district, is built on a high point on the left bank of the river. There is a windmill behind the fort, and a good deal of land enclosed for cultivation. The river is here 200 yards wide, and enclosed by banks 160 feet high, in which are exposed sections of the beds which contain coal. This coal occurs in three or four beds, the principal of which is from four to six feet thick. It is of very inferior quality, burns with no flame, but rather smoulders away, leaving a plentiful ash. The beds associated with it are of grey sandy clay, containing ironstone nodules, and also argilo-calcareous shales. It is used in the forge at the fort, and is found to answer tolerably well.

The half-breed settlement, where I expected to find men, I found to be situated about fifty miles to the west of Edmonton; but as I learnt that all the population was absent on the plain hunting, I did not visit it at this time.

On the 9th of January I started for Rocky Mountain House, for the first three days travelling due south nearly, and afterwards turning to the west for three days more, arriving at that place on the 14th. The distance I found to be 157 miles, but there was little or no snow on the ground, so that it was very hard work for the dogs. The road lay over a succession of wooded ridges, the western slopes of which were covered with young poplars, while the eastern slopes and the swampy valleys between support a growth of spruce.

From a rising ground, known as Gabriel Hill, I obtained the first view of the mountains the evening before I arrived at the fort.

I found the Mountain House to be an establishment about the size of Fort Pitt, but in a very ruinous condition, owing to its being abandoned every summer, when it is generally adopted as a residence by several families of Indians, who prove anything but improving tenants.

It stands on the left bank of the river, which is 150 yards wide, and about half a mile above the mouth of Clear Water River, a large branch which joins the Saskatchewan from the S.E.

I remained here until the 26th, making excursions in every direction for the purpose of examining the beds exposed in the banks of the main river and its tributary, which are very interesting. They belong to the same series as those at Edmonton, and coal is found abundantly, although no bed that was observed is more than two feet thick. The principal feature of the river here, however, is the occurrence of thick beds of incoherent sandstone of coarse texture which forms cliffs sometimes 100 feet high, overhanging the river, giving it a very different character from the tame sloping banks lower down in its course.

The Mountain House is at the distance of not less than 100 miles from the main chain of the Rocky Mountains, which are nevertheless distinctly seen from it as a chain of snow clad peaks. The principal chain is, however, screened by a nearer range, distant about 45 miles. The view of the mountains occupies the arc of the horizon, from south by east to west by north. The near, or Brazeau range, merges with the main range towards the north, but lying more east and west than the line of lofty peaks, at its southern extremity, it is far distant from them.

I made an attempt to reach this near range, but failed in forcing a road through the dense pine woods with which the whole country is covered.

For a short time after my arrival the place was reduced to great straits for provisions, but a camp of Blackfoot Indians arrived, bringing with them a small quantity of dried provisions so as to give temporary relief.

I met six of the principal chiefs of the Blackfoot Natives, and explained to them the objects of the Expedition, and the course it would likely pursue when passing through their country, and obtained a promise from them that they

would take steps to prevent the young braves of the nation from stealing our horses or otherwise molesting the party. I gave each a small present and a paper in which their promise was embodied. The lat. of the Mountain House is $52^{\circ} 29' N.$, the long. by account $115^{\circ} 2' W.$

By a comparison of observations made with the barometer during my stay, and those at similar times at Fort Carlton, I found its altitude above that place to be 2,029 feet.

The mean temperature for the time I was there is 10° higher than for the same time at Fort Edmonton, but for many days a soft south-west wind blew, which does not seem to have affected the temperature at Edmonton in the same degree, which accounts for this great difference.

Having obtained all the information concerning the country which might be of use to you in making your plans for next year, and learnt the names of the best guides, &c., I started on my return to Edmonton House on the 26th of January. In order to obtain a clearer understanding of the structure of the country, I descended on the ice of the river all the way, and found the distance to be 211 miles. As we were only sparingly supplied with provisions we had to go very fast, and reached Edmonton after having slept only three times. The last day of the journey, as we had nothing left to eat, we did not think it worth while stopping, so we travelled 21 out of the 24 hours, and in that time went 90 miles.

The coal-bearing strata are exhibited more or less continuously throughout the whole of this portion of the river, but about 130 miles above Edmonton the last of the sandstone bluffs is seen, and the strata assume the argillaceous character which they present at that place. Sections and a minute description of these strata, along with my journal, will be, however, submitted to you.

The month of February was occupied at Fort Edmonton in making an examination of the surrounding country and other observations. I made an excursion to Lake St. Ann to visit the Settlement and Roman Catholic Mission there, under the superintendence of M. Le Combe. It is 50 miles W. by N. from Edmonton, and consists of 45 houses in three little villages on the west shore of the lake, which is about 14 miles long and 7 wide. There is a nice little chapel, but at the time of my visit all the inhabitants, with the exception of three or four families, were absent on the plain.

On the 7th of March I set off to the plains to meet the Freemen, having heard that they were now all together and on their return. I met them in the neighbourhood of Battle River, and succeeded in engaging the guides and men I wanted. These freemen seem to be a thriving class, and have none of that love of personal display and extravagance which is such a blot on the character of the Red River half-breeds.

On the 15th of March I left Edmonton, and continued to descend the Saskatchewan on the ice. Four miles below Fort Edmonton I saw the coal for the last time, and at the distance of 80 miles the associated beds disappear, and the clay strata with the ironstone nodules, which were first seen at the elbow of the south branch last year, and which are of cretaceous age, take their place in the bank of the river, to all appearance having the coal-bearing strata conformably superimposed.

As we approached Fort Pitt we found the snow on the river, and also all over the country, to be very deep, so that for the first time throughout the whole trip we had to take snow shoes in earnest, which says a great deal for the unusual mildness of the winter, or rather the absence of snow, for the cold at some periods was very severe. I found the distance by the river to be 251 miles. The heat of the sun, from melting the surface of the snow, caused us to travel during the night, and rest in the day, during this part of the journey. I arrived at Fort Pitt on the 21st of March, but finding that letters had missed me on the road, I had to wait there until the 30th. The ice on the river was

now getting so bad that it could no longer be safely travelled on, so that I had to return by the usual track to Fort Carlton. On the 1st of April I reached Jack Fish Lake, where I found Mr. Sullivan, he having been obliged to leave Carlton on account of the scarcity of provisions.

At this place I had to give up the use of sleighs, as the ground was now quite bare. I had *travaillies* made for my dogs after the method of the Indians, and along with Mr. Sullivan in this manner we reached Carlton on the 8th of April.

Here I found the men you had engaged at Red River, and who had only arrived the day previously. As the people at the Fort were next thing to starving, I at once despatched them to the nearest point where buffalo were to be found, so that they might hunt for themselves.

Until the 7th of May I was occupied at Carlton, when I again started for Fort Pitt to meet the men I had engaged, and whom I had directed to come to that place with the Company's annual brigade of boats. I had already sent up a supply of clothing, &c. for them.

I got to Fort Pitt on the 10th, but the unusual lowness of the river delayed the brigade, so that it did not reach that place until the 15th and 18th. I then got the horses ordered from the Company, and which were in readiness at Fort Pitt, and sent the men at once to a rendezvous to the south of the Eagle Hills, where in all probability they will meet with the party of Red River men. I did this, as it was impossible for them to be fed at Fort Pitt, as the buffalo were distant many days. Two of the party are to come on to Carlton, to guide us back, so as to avoid any chance of missing them.

On the 22nd of May I left Fort Pitt, to descend the river along with the brigade, and so complete the survey of it (which I had made during the winter, from about one day above the Mountain House) as far as Carlton. The distance, by the river, between the two places is about 235 miles, and it occupied us seven days. These boats draw only one and a half to two feet water, and are led by guides long used to navigate the river; yet from the shallowness of the water, and the great intricacy of the channel, the boats were constantly running aground, keeping the men wet from morning to night, from having to jump into the water every time to shove them off.

The river above Carlton is certainly unnavigable this season except for the smallest craft, and even then only with great difficulty.

While at Fort Pitt, waiting for the brigade, I had an opportunity of examining the cretaceous beds, and obtaining a few more of the characteristic fossils. At about ninety miles above Carlton, or about forty-five miles above the elbow of the north branch, they were observed for the last time in a section of the flank of the Eagle Hills.

From Mr. Swanston, the gentleman in charge at Fort Edmonton, I received a valuable meteorological register which he had kept, with a thermometer furnished by myself, continuously from the 1st of January till the 15th of May.

By a comparison of barometer readings at Edmonton during the months of January and February, with the similar readings at Carlton, the approximate difference of altitude between the two places is found to be 922 feet.

This meteorological register, with all other meteorological and other observations, along with the journal of this trip, will be submitted to you as soon as completed.

I have, &c.,

JAMES HECTOR, M.D.

To Captain PALLISER, Commanding North
British American Exploring Expedition.

No. 2.

Read, February 14, 1859.

Fort Carlton, Saskatchewan, June 5, 1858.

SIR,—I have the honour to report my arrival at this post on the 4th of June.

Owing to the absence of buffalo during the winter, my hunters, as well as those belonging to the Fort, have had to go to great distances in order to get meat, which they obtained in such small quantities that the Hudson Bay Company's officer in charge of this post was obliged to scatter the men with their families all over the plains in search of food. Even Dr. Hector and Mr. Sullivan were obliged to leave this post and go to Forts Pitt and Edmonton in order to lessen the consumption of meat, for which the supply here was quite inadequate; fortunately, however, the winter has been an unusually mild one, otherwise the consequences might have been very serious indeed.

I am happy to say that I have been most fortunate with regard to the horses; very few have died, and almost all the rest are in good working condition, and in far better order than when I started last year from Red River.

I am now about to start with the main branch of the Expedition to the Forks of Red Deer and Medicine Rivers, and dispatch Lieut. Blakiston with a branch expedition, via Forts Pitt and Edmonton, in order to carry on the magnetic determinations at those posts, as well as to bring us supplies overland in carts, ordered up in boats from Norway House last winter, to meet us at the Forks above mentioned. Lieut. Blakiston, with the supplies, will join the main branch of the Expedition, and we shall proceed to an old Fort at the foot of the Rocky Mountains not far from the boundary line, thence I shall trace the boundary line to the westward, and afterwards take a course to the northward in search of a pass practicable for horses over the Rocky Mountains within the British territory.

I purpose then to send the Expedition into winter quarters at Edmonton, and proceed with one or two men across the Rocky Mountains to meet Captain Hawkins.

I am in receipt of your last communication of the 29th of March, conveying the suggestion of the Royal Geographical Society, viz., "to deposit for Captain Hawkins's use at Fort Assineboine the records of my observations to the north of the 49th parallel." Fort Assineboine was situated on a tributary of the Mackenzie River which flows into the Arctic Ocean; the post has for several years ceased to exist, and I hope to avail myself of an easier way to communicate with Captain Hawkins, as I learn that Mr. Dallas of the Hudson Bay Company is crossing the mountains by way of

the boat encampment and Athabasca portage; and the men who return with the boats down the Colúmbia can take back despatches from me. I intend to adopt this means of communication in case I might subsequently fail in finding a practicable pass for horses across the Rocky Mountains within the British territory, and so fail in having a personal interview with Captain Hawkins.

I enclose letters from Lieut. Blakiston and Dr. Hector, and Mr. Sullivan, concerning their operations during the winter of 1857-58. Also M. Bourgeau's botanical report, which I shall feel obliged by your submitting to Sir William Hooker.

I have likewise the honour of enclosing the map of our explorations in 1857, containing also my route from Red River this spring.

As soon as my men are all collected from the plains where they have been in search of food, and making provisions, I shall start the Expedition. This will probably be effected about the 12th of this month.

I would strongly recommend Her Majesty's Government at the termination of my Explorations to attach Lieut. Blakiston to Capt. Hawkins's staff, in order to continue across the Rocky Mountains his very valuable series of magnetic and meteorological observations.

I have, &c.,

JOHN PALLISER, Captain,

Commanding N.W. American Exploring Expedition.

*Her Majesty's Secretary of State
for the Colonies.*

No. 3.

Read, February 14, 1859.

Fort Edmonton, Saskatchewan, October 7, 1858.

MY LORD,—I have the honour to report the safe return of myself and my secretary, Mr. Sullivan, to winter quarters; also the return of Lieut. Blakiston with the branch expedition I had sent to explore the Kutanie Pass. I have also to report the return of M. Bourgeau, whom I also sent on a botanical tour into the Rocky Mountains, with directions to follow any route where he thought he could best further the interests of botany.

I am rejoiced to say that I have completely succeeded in discovering not only a pass practicable for horses, but one which, with but little expense, could be rendered available for carts also. This pass will connect the prairies of the Saskatchewan with Her Majesty's Possessions on the west side of the Rocky Mountains. The pass is

situated precisely where I had long supposed, and this impression was communicated by me to Her Majesty's Government previous to my appointment to the command of the Expedition.

I shall now endeavour to give a summary of the movements of the Expedition, since the commencement of June, 1858, up to the present period; also of the branch expeditions of the gentlemen whom I despatched at different times for that service.

Early in the month of June, I despatched Lieut. Blakiston, by Fort Pitt and Fort Edmonton, on the north branch of the Saskatchewan River, in order to carry on the magnetic determinations at those posts, as well as to bring us supplies overland, which supplies were every day expected up in the boats. I then started with Dr. Hector, M. Bourgeau, and Mr. Sullivan, for the Eagle Hills, with the intention of exploring the region of country between the north and south branches of the Saskatchewan or Bow River. I was then accompanied only by the men I had engaged at Red River Settlement, and with them went as far as the Cross Woods, where I left them along with the gentlemen, with orders to await my return. I then started with two men and one pack-horse, and rode about 80 miles in quest of my St. Ann Brigade, whom I had sent on the prairie to the south of the Eagle Hills, in search of buffalo, the game being so scarce that I could not run the risk of keeping so large a party together. After two days' ride I found their camp; they had not only lived well, but had been able to comply with my directions, to dry meat for us, for we had started almost without provisions. I lost not an hour in leading them to join my Red River Brigade, and on the fifth day reached the Expedition at the Lizzard Lake. Here we passed our first Sunday.

All my Red River men belonged to the Church of England, consequently I read prayers for them. The St. Ann men, half breeds, although of the Catholic persuasion, asked and obtained leave from me to attend Divine worship, and I conducted the lessons and half the prayers in Cree through the medium of an interpreter. I mention this circumstance to show the respectful tendency and absence of bigotry of these men in their appreciation of Divine service.

Our supply of provisions was very small; we had meat only for three days, and about three stones of flour, for a party consisting of my three companions, myself, and 28 men. I had, however, tea and sugar remaining from last year's store, which, together with what I brought from Red River Settlement, has lasted us pretty well through the season.

The absence of all flour and vegetables did not inconvenience either us or the men in the least, and I found the tea very useful in counteracting the injurious effects of the swamp water, which otherwise might have produced many cases of dysentery.

The country surrounding the Eagle Hills and Lizzard Lake is rich, and wood abundant; but the timber is not of a valuable description, being chiefly poplar and willow. Here I learned that the war had broken out between the Cree and Blackfoot nations, and that a large number of Indians were on their way to pay me a visit. Knowing that they would have little or no provisions to trade, and fearing their importunity, I made a few forced marches and got into the Blackfoot country.

On the 22nd June we reached the 108th degree of west longitude, in lat. 52° N. The ground offering very bad pasture, was very inferior land, and we travelled the prairie without wood, depending on a scanty supply of buffalo dung, which we collected in order to cook our meals.

After passing the Ear Hills on the 24th of June, we reached the Grande Coulee, and camped near a lake three miles long and two wide, where we at length found some wood (willow and poplar, with a few birch). We were here out of provisions, but fortunately fell in with bands of buffalo. The weather was very cold and stormy, and the rain fell in torrents. We killed, however, sufficient buffalo for our present wants. Here I had the misfortune to lose one of my finest horses while cutting up a buffalo. The horse was attached to the dead bull's horn, and took fright at one of the men coming over the brow of the hill with a load of brushwood; he broke his halter and made his escape on the plain. Instantly four of my best mounted men started in pursuit; the rain poured in torrents, driven by the storm against their faces. They continued till dark night in vain; the intrepid fellows, without a coat or a blanket with them, passed the night on the broad prairie, with not a shrub to shelter them from a terrific thunderstorm, and as soon as day dawned took up the horse's tracks, mounted, and recommenced their pursuit. All their exertions, however, were in vain, for, unfortunately, the horse was a very swift, powerful animal, a finer one than any in pursuit of him.

In consequence of the severity of the weather, and the great hardships the men had undergone, one of them was seized with acute inflammation of the lungs, which delayed us for eight days. This time I could hardly consider lost, as the weather continued very wet, and the horses were much in want of rest.

We were now in the Blackfoot country, and had to guard our horses strictly every night, I myself and each of the gentlemen with me keeping watch in turn, and during the daytime keeping scouts on the "look-out" in every direction.

At length, on 3rd July, Antoine Shaw was sufficiently recovered to be removed, and the Expedition continued its course to Battle River, the weather very cold and stormy, with several severe hail

showers, the stones striking so hard as to cause pain to ourselves and the horses.

I will not occupy your Lordship's time with minute details of our journey from this, as the prairie was neither well provided with wood nor rich in pasture, but will pass on to the period of our arrival at the Battle River.

On 7th July we arrived at Battle River, a large but unnavigable tributary of the Saskatchewan, crossed the stream, and encamped in about lat. 52° N., long. 111° W. Here we found fine rich soil, well adapted for pasture and agricultural purposes. The river at this point takes a wide sweep to the south: instead therefore of continuing up the stream to the southward and then again to the northward (*i. e.*, round the bend of the river), I determined on holding my direct course, and despatched Dr. Hector with two men on horseback and one pack-horse to follow the bend of the river and meet the Expedition again, where I proposed re-crossing the stream, about 40 miles to the westward. The Doctor reached me on the 11th, the day after I arrived at my second crossing place, having laid down that portion of the river, and fully confirmed my expectations as to the fertility of the country through which it flows. Here, also, we had seen the first pines since our departure from the north branch of the Saskatchewan; and although *now* no longer in large number, still there are indications of their having existed here in great abundance, and of a large size. Unfortunately the Indians have a most disastrous habit of setting the prairie on fire for the most trivial and worse than useless reasons. If a war party returns, if a hunting party starts, even if a single individual wishes to signal his camp, the invariable method resorted to is "firing the prairie." The result is, all their invaluable timber, such as pines and deals of every kind, perish for ever off the face of the earth, leaving nothing hereafter to spring up in their place but willows and poplars. Hence year after year willows are sacrificed for ever, which would bring wealth, warmth, and the means of transport to the future settler, who might till the soil and navigate its streams.

At our second crossing place of Battle River I was visited with great ceremony by a large camp of *Circees*. These Indians, though differing widely from the Blackfeet, and speaking another language, are allies to the latter. They are very poor and troublesome, and sometimes riotous and disorderly. Although the old men and chiefs were well-disposed towards us, we had reason to congratulate ourselves that our party was so strong, otherwise I do not think the chiefs would have succeeded in their endeavour to keep the young men from attempts on our horses. We spent an anxious night, all keeping watch, and the next day we made them

a few presents, exchanged a few tired horses, and parted on very good terms.

Our course to the westward from Battle River continued through a soil of fine vegetable mould two feet deep upon a substratum of sand. This portion of country was no doubt formerly forest lands, but now converted into prairie by the frequent occurrence of fires which overrun the country.

On the 14th July, when nearly out of provisions, buffalo were discovered to our south at a great distance. I despatched Mr. Sullivan with the hunters, followed by three carts, to hunt, being uncertain as to whether we should again find buffalo to the westward. On the return of the carts, I gave orders to remain here a few days, to slice and dry provisions for at least ten days' consumption.

I started from this encampment in a W.N.W. direction to the Bull Lake, and left orders that the Expedition should go on their course to the Red Deer River, where I would again join them. The Bull Lake is nine miles long and seven broad, and is connected to the Red Deer River by an insignificant stream issuing from the southern extremity of the lake. I think this lake would be a desirable place for a settlement: the soil is good, and the lake is in proximity to the Red Deer River, a large navigable tributary of the south branch of the Saskatchewan. There is, however, no valuable timber at the lake itself, but ample quantity could be obtained both at the Red Deer River and its tributary, the Medicine River, where the white spruce and rough barked poplar are in abundance.

On July 24th we camped on the edge of the woods, in lat. $51^{\circ} 52' N.$, long. $114^{\circ} 10' W.$ I determined there to await the arrival of Lieut. Blakiston, who was to join us after having gone by the regular cart track, via Edmonton, in charge of ammunition, flour, and a few articles for Indian presents. We waited three or four days, and with difficulty supported ourselves on deer, which were very scarce, as the Assiniboinés had hunted there all the spring. At length, on the 29th, I directed Dr. Hector to proceed to the forks of Medicine and Red Deer rivers, and bury a letter for Lieut. Blakiston, informing him that we were obliged to move onward from scarcity of provisions, and acquainting him how he was to steer his course in order to fall on our trail.

On July 30th we again broke up camp; and as I intended to send a part of the Expedition by the same route to winter quarters from the Rocky Mountains, I there made a cache of all the articles that we could possibly dispense with, in order to lighten the Expedition as much as possible, and enable us to abandon the carts for a time, hide them, and proceed with pack-horses.

All these arrangements being completed, we started at 8-30

A.M.; and as we were camped at 1 o'clock for dinner, Lieut. Blakiston, with his carts and horses, overtook us. He brought us the news that the boats had not arrived, and he was obliged to leave without the stores; but he succeeded in bringing me some ammunition from Edmonton, which after all was the only thing of vital importance.

We were now without provisions, but still continued our course. In the evening, however, two of my scouts came into camp, and reported a large band of buffalo about twelve miles to S.E. The next morning we started before sunrise, and travelled till 9 o'clock, when we came within hearing distance of the tramping of the animals. Here we camped, saddled the runners, and started after our game; we had an admirable run, and killed sixteen. All hands then went to work to prepare and dry meat for the period that we should travel among the Rocky Mountains; because I was aware that, once we entered that range, we should have little or no chance of finding anything to eat. We all worked hard slicing and drying, made our provisions, and were ready to start on the 4th August.

As I had ample time before the close of this season to seek for the pass, the existence and place of which I was in search of, I determined to ride to the boundary line and examine the country from the mountains eastward, and took with me Mr. Sullivan. I left Dr. Hector and Lieut. Blakiston, and M. Bourgeau, to proceed to the Old Bow Fort, or Chesterfield House, with the main body of the Expedition, under charge of Dr. Hector, with orders that, as soon as they had arrived at the site of the Old Fort, he should place the carts in "cache," despatch the gentlemen on their different missions, proceed upon his own, and direct the remainder to await my secretary's return from the boundary line: M. Bourgeau to enter the mountains and proceed with three men and seven horses on a botanical exploration, wherever he thought best; Dr. Hector with another party, to go on a geological tour; Lieut. Blakiston to proceed through the mountains by the two known Kutanie passes, returning by the southern one.

I started at noon from our camp, known as Slaughter Camp, lat. $51^{\circ} 20' N.$, long. $113^{\circ} 45' W.$, and kept on a southern course along the prairie. We only found salt lakes; and though we rode till 11 P.M., we camped without fire or water, but next morning reached the Lower Saskatchewan or Bow River, in lat. $50^{\circ} 55' N.$ We crossed the river after breakfast, found it very deep, our horses as well as ourselves being obliged to swim. The country we passed over on the north side of the river has a wretched soil; but when on the south side, the appearance and soil changed greatly for the better. We crossed numerous well-wooded rivers,—many of them containing valuable timber, such as pines, spruce, &c.,—the valleys

and neighbouring soil of which were rich and desirable for cultivation; but whenever we struck out on the broad prairie, we generally found the soil worthless, except here and there in small swamps. Although my journey to the western extremity of the boundary line was necessarily a rapid one, I determined on a visit to the "Cypress Hills." I was anxious to see this part of the country, in consequence of having heard many reports of its wonderful timber and fine rich soil. I found great tracts of splendid timber wasted by fire; there still remain, however, many valuable pines, and the land is rich, and capable of producing several grain crops in succession without manure.

On August 8th we arrived at the 49th parallel, the prairie stretching to the east, utterly devoid of wood save in the valley of the Great Belly River. The locus of 49th parallel is very strongly marked by a high prominent mountain, called the Chief Mountain, in full view of which the Indians meet in the autumn, and perform some characteristic dances. I only remained one day, which I devoted to riding in an easterly direction, and climbing elevations to obtain an extensive view of the country to the east, but saw nothing but prairie of the poorest kind, and destitute of timber. The next day I arrived late in camp, and we started for the Old Bow Fort, where we arrived on 14th August.

The site of the Old Bow Fort is in lat. $51^{\circ} 9' N.$, long. $115^{\circ} 4' W.$, at the foot of the Rocky Mountains. The chimneys of the place are still standing. The Hudson Bay Company have long abandoned the post, many of their servants having lost their lives in its defence. Although the timber here, consisting of fine prusche, Banksian pine, spruce and red pine, is valuable, the soil is scanty, the river valley being occupied by immense deposits of shingle.

On my arrival at the Bow Fort I found my hunters waiting for me. They had been out in every direction, but could not fall in with buffalo; they had also found elk and deer very scarce. In addition to this, they were in great fear of the Blackfeet and Blood Indians, whose return from the south-east would soon be daily expected. I was therefore obliged to alter my plans, and desire them only to await the arrival of M. Bourgeau, and afterwards to proceed to the forks of Red Deer and Medicine Rivers, and there to await the return of Mr. Sullivan, whom I was to send in charge of my branch expedition as soon as I had searched for my pass back from the mountains, I myself proposing to proceed westward to meet Captain Hawkins and visit Vancouver. I regret, however, that a letter from Lieut. Blakiston was handed to me by one of my men, acquainting me that "his position in Her Majesty's service would not allow of his considering himself in any way connected with the Exploring Expedition under my command."

This step of Lieut. Blakiston deranged my plans a little, and is

partly the reason why I have determined on wintering on this side of the mountains.

On the 18th of August I started to seek for the new pass across the Rocky Mountains, proceeding up the north side of the south branch of the Saskatchewan or Bow River, passing the mouth of Kananaski River. Five miles higher up we crossed the Bow River and entered a ravine. We fell upon Kananaski River and travelled up it in a south-westerly direction, and the following day we reached Kananaski Prairie, known to the Indians as the place "where Kananaski was stunned, but not killed." On the 21st we passed two lakes about two miles long and one wide. We continued our course, winding through this gorge in the mountains among cliffs of a tremendous height, yet our onward progress was not impeded by obstacles of any consequence; the only difficulty we experienced was occasioned by quantities of fallen timber caused by fires. I observed that many, indeed most of these tremendous fires are caused by lightning, and in one or two places traced their progress where the foot of man could never have trod.

On the 22nd of August we reached the height of land between the waters of Kananaski River and a new river, a tributary of the Kutanie River. We remained here for the rest of the day, occupied with observations. Our height above the Bow Fort was now 1,885 feet, or above the sea 5,985 feet. Next morning we commenced our descent, and for the first time we were obliged to get off and walk, leading our horses down a precipitous slope of 960 feet over loose angular fragments of rock. This portion over, our route continued for several days through dense masses of fallen timber, destroyed by fire, where our progress was very slow, *not* owing to any difficulty of the mountains, but on account of the fallen timber, which we had first to climb over and then to chop through to enable the horses to step or jump over it. We continued at this work from daybreak till night, and even by moonlight, and at length reached the Columbia Portage on the 27th of August. Here I devoted a day to ascending some heights in search of a view of the Columbia River. After climbing several mountains in vain, I at last was astonished to find myself right upon the bank of the lake from which the Columbia rises, at a height of about 2,300 feet over the surface. Climbing a high tree in order to overlook the woods which intercepted my view, I saw both the Columbia lakes, the Columbia rising out of the southern, flowing into the northern one, out of which it bends to the westward previous to taking its northern course to the boat encampment. The most southerly of these lakes is in lat. $50^{\circ} 7' N.$, long. $115^{\circ} 50' W.$

On the 30th of August we arrived in lat. $49^{\circ} 36' N.$, long. $115^{\circ} 37' W.$ on the Kutanie River, where we found a camp of Kutanie

Indians. These are the most wretched-looking fellows I ever met; men, women, and children, all living on berries, the men naked, and the women nearly so: yet, strange to say, although these people were starving, and destitute of clothes and ammunition, they possess a wonderful number of horses, and those very superior to the Indian horses on the east of the Mountains. Yet I had considerable difficulty in training horses for the Expedition, and those I did succeed in training were not from among their best horses, neither could I obtain more than one or two horses for mere trade, although they were most anxious to exchange horses, even greatly to their own disadvantage.

I had eleven horses with me. Most of them were in wretched condition, and many of them worn-out, unserviceable animals, yet these were eagerly exchanged and good ones given in their stead, particularly when a little present of two plugs of tobacco and fifteen balls and powder were advanced. Indeed, only for my having effected these exchanges of horses, I hardly think I should have succeeded in bringing back all the horses I had started with from the Old Bow Fort, some of which had also been with me on my previous rapid trip to the boundary line.

I learned from the Kutanies that there was a very plain, easy road to Fort Colville, distant eight days from their camp; but as they had quarrelled with the Flat Heads, not one would volunteer to come with me as guide. However, that circumstance would not have deterred me from proceeding westward to meet Captain Hawkins and visiting Vancouver, had I known what Lieut. Blakiston's intentions were, and, indeed, it was not until after his return to Edmonton that he could communicate them to me. I merely state them without note or comment.

On September 6th I started to re-cross the mountains by the Kutanie Pass, and was surprised to find that pass also within the British territory.

We entered it in lat. $49^{\circ} 11' N.$, long. $115^{\circ} 21' W.$ in the valley of the Elk River, and came out on the east side of the mountains in lat. $49^{\circ} 32' N.$, long. $114^{\circ} 35' W.$ in the valley of Little Belly River. It is one frequently used, but not the general pass of the Kutanie Indians, who have a preferable one in the American territory.

On September 7th we passed the height of land, a formidable ascent, where we had to walk and lead the horses for two hours. This is the height of land which constitutes the watershed. We encamped for the night in a small prairie, after making a considerable descent. On the 8th of September our course continued through woods and swamps, for about 15 miles, till we arrived at another ascent; this was also a severe ascent, though not so formidable as that of the day previous; we reached its summit

about four o'clock, through a severe snowstorm, the snow falling so fast as to make me very apprehensive of losing the track. We descended that evening, and camped on the eastern side, and next day arrived at the eastern extremity of the pass. I regret that I cannot give the altitudes on this pass, as our barometer was broken by one of the horses. It is, however, far from being so favourable as the more northern one by which I entered on Kananaski River, which has but one obstacle in height of land to overcome, and where the whole line of route is free from swamps and marshes.

I will not take up your Lordship's time with an account of our journey from the Kutanie Pass to Edmonton, as I have given a description of the greater part of the country already.

I have great pleasure in reporting the arrival of Dr. Hector while I have been writing this letter. I have been very anxious about him, knowing how badly off he must have been for provisions. He has had a very severe journey, and much trouble in finding game enough to support himself and party. He has amassed a large stock of information in the mountains, geographical as well as geological. He is very anxious to penetrate farther across to the west, but unfortunately my instructions prevent me from permitting him to do so, however desirable I might consider such a journey to be. In addition to being an accomplished naturalist, Dr. Hector is the most accurate mapper of original country I have ever seen, and is now an experienced traveller. By long and severe journeys with dogs and snow shoes last winter, in connexion with his hard trip this autumn, he has laid down the whole north branch of the Saskatchewan, and the south branch from where we met it to the glaciers of its source; and there is no department of the Expedition in which he is not only competent, but willing to assist.

I have the honour of enclosing Dr. Hector's report of his explorations, and there are two facts connected with that portion of country to which I wish particularly to draw your attention.

1st.—Dr. Hector followed the Bow River right up to the main watershed of the continent, then followed it until he reached a transverse waterparting, which divides the waters of the Columbia and those of the north Saskatchewan on the one hand, from those of the Kutanie and south branch of the Saskatchewan on the other. There he found the facilities for crossing the mountains so great as to leave little doubt in his mind of the practicability of constructing even a railroad connecting the plains of the Saskatchewan with the opposite side of the main chain of the Rocky Mountains.

2nd.—Dr. Hector informs me that the water-line of the mountains is not identical with their geological axis; this axis he was unable to reach, and had only opportunity of examining what are called flanking ranges: therefore the most important geological results

relating to the Rocky Mountains of North America remain as yet unascertained, because, in conformity with my instructions, I was obliged to order Dr. Hector not to advance farther than the axis of the watershed of these mountains; and I take this opportunity of recommending Her Majesty's Government to alter that part of my instructions, and direct my movements in the following manner:—That as soon as my explorations are completed on the east side of the mountains (for now there remain 6° of longitude in the country of the boundary line), I should send Dr. Hector to complete his exploration, and then meet me at Fort Colville, whence we could return home to England by Panama, and the British West Indian mail steamer from Chagres, a far cheaper route than recrossing the whole continent of North America. Besides this, it will enable me to dispose of all my horses to great advantage, and even to make money to credit side of the Expedition in the account for horses. The Hudson Bay Company are very short of horses: they allow me 20*l.* each for 25 horses now, and have promised to purchase all the others I can spare next year. I have now 53 horses, almost all of which are sure to outlive the winter; I have lost but three or four this year, and may lose five this winter: however, I have not neglected any precaution in my power; I have cut and stacked hay for them, and am constructing a shelter for those that may require it after Christmas.

As to my expenditure this year, it is not easy to give an exact statement, as the accounts are all priced at *La Chine*, and I am too far distant to go down and settle them, as I did last year. They will, however, hardly exceed 2,000*l.* by more than I can counterbalance by the sale of the horses. The expenses of next season will exceed 1,500*l.* if anything at all is to be done. But if Her Majesty's Government are really apprehensive of the grant of 1,500*l.* being overdrawn, I have but one course to pursue, that of abandoning the completion of the boundary line, and all discoveries in the Rocky Mountains, and returning home in the beginning of the season. It is quite true that my expenses for this financial year will not have been so great as those for the financial year 1857-8; but any one acquainted with this expensive country will inform Her Majesty's Government that 1,500*l.* is hardly sufficient to cover a season's explorations, particularly when the salaries and home journey expenses are to be deducted from it.

I feel greatly honoured by the confidence Her Majesty's Government have hitherto placed in me, and should Her Majesty's Government consider the importance of ascertaining the practicability of a railroad across the Rocky Mountains, as well as a more extended acquaintance with the geological structure of those mountains themselves, worth the further sacrifice of a few hundred pounds, I would propose that the Government grant me the whole

of the 1,500*l.* for expenses in this country alone for the next season, independent of salaries and the homeward travelling expenses, the former of which will amount to 570*l.*, and the latter, I hardly think, will exceed an equal sum, if I am allowed to adopt the route I propose as most conducive to the interests of science as well as the purposes of economy. The only objection that can be urged to this proposition is, that Captain Hawkins and his party have been sent to the west side of the mountains. But their work, as far as I understand, will confine them to the neighbourhood of the 49th parallel, and they will not have the same facilities for accomplishing those objects as I shall, starting from the eastward in a higher latitude, where the country is safe and a small party can travel, nor could they effect them as rapidly and economically as I could.

My plan is to send Dr. Hector to pursue his discovered route, which my instructions compelled him to abandon, while I and my secretary, Mr. Sullivan, will follow a different line of traverse to the Pacific, so as to ascertain as much as possible of the nature of the country lying between the mountains and the sea north of the 51st parallel.

M. Bourgeau, who has made a magnificent collection of Alpine plants during his tour in the mountains, will return to London, *via* Pembina and St. Paul's, in order to fulfil his botanical engagements for 1860. I have to express my thanks to him for his most unceasing exertions, not only in his botanical labours, but for his zeal and care as manager of the provisions and stores of the Expedition, and his anxiety to assist me in every possible way.

I have also to express my satisfaction with my secretary, Mr. Sullivan, not only for his zeal and assiduity in carrying on the astronomical observations, but for his assistance and exertions for the interests of the Expedition, particularly with regard to the horses; likewise for his care and regularity with the accounts, which, in a country where everything is conducted on a system of "barter," are of a very complicated nature.

I have the honour to enclose two maps. The first contains the routes of the whole Expedition, together with those of the branch parties. The other is a rough enlargement of a portion of this, in order to display with greater clearness our different routes of exploration while in the mountains. The map is not final as regards the mountains, as Dr. Hector's longitudes are by account, and may require correction; the remainder, however, is completed, and I beg it may be preserved, as we have no time to make a copy.

We have barely returned from the plains into Fort Edmonton in time to receive and answer our letters by the "fall boats," which start again immediately after they are unloaded, to anticipate the setting of the ice. Our time, therefore, is very

short; and although I have troubled your Lordship with a long letter, yet I have been obliged to omit a great deal of information contained in the journal.

Fort Edmonton is the largest trading post in the Saskatchewan. A little agriculture is carried on; they grow tolerable wheat, and grind it in a windmill. The potatoes are excellent, and horned cattle continue out the whole winter, and still are thriving. However, I cannot observe much as yet; my whole time has been occupied with the men's accounts and the correspondence.

The Red River men return to Carlton by the boats, where I have made arrangements for their conveyance to Red River Settlement, and give them the balance of their pay in orders on the Hudson Bay Company. The Lake St. Ann men are paid in goods, as money is not known in this country, and I am now giving them value for their wages in goods ordered by me for the Expedition, charging them the Company's prices. It would be impossible to send an account down now, but I will forward one by the winter express, along with the whole corrected map of the Expedition, and the observations.

I must now beg leave to draw your Lordship's attention to that portion of my original instructions of March 31, 1857, which directs me as follows:—

“You will endeavour from the best information you can collect to ascertain whether one or more practicable passes exist over the Rocky Mountains within the British territory, and south of that known to exist between Mount Brown and Mount Hooker.”

In accordance with these instructions, I first obtained the best information I could collect, which proved so vague as to be utterly valueless. I then directed Dr. Hector to undertake the more northern search (*i.e.*, between the two branches of the Saskatchewan River); I myself, accompanied by Mr. Sullivan, undertook the search from the south branch of the Saskatchewan to the pass of the probable existence of which I had informed Her Majesty's Government before receiving the command of the Expedition. I directed Lieut. Blakiston to undertake the Kutanie Passes supposed to be in American territory. Lieut. Blakiston threw up his command in order to carry out that object independent of me; but with the assistance of Mr. Sullivan, I was also able to effect that portion of what was to have been his duty myself. This comprised the southernmost pass within the British territory. Lieut. Blakiston's exploration may perhaps have a value hereafter as a corroboration of my own.

The fact is that the knowledge the Indians possess of the mountains is very small; even among those said to “know the mountains” their knowledge is very limited indeed. This is easily accounted for by the scarcity of the game, which offers no induce-

ment to the Indians even to go there. I fear if Dr. Hector leaves this country without completing his pass, much difficulty might arise hereafter in finding the exact point of the western exit of the valley, as it is very small, and the woods dense, and no one could find it as the Doctor himself. Besides, the most unfavourable result would even be desirable in that case, as it would set the question of the possibility of the easy construction of a railway across the Rocky Mountains for ever at rest.

I will now enumerate the several passes which have been discovered and laid down.

1st. From south branch Saskatchewan to Kutanie River:

Two, *i.e.*, Kananaski Pass and Vermilion Pass.

2nd. From Kutanie River to Columbia:

Two, *i.e.*, the Lake Pass and Beaver Foot Pass.

3rd. From south branch Saskatchewan to north branch:

One, *i.e.*, the Little Fork Pass.

4th. From south branch Saskatchewan to Columbia:

One, *i.e.*, the Kicking Horse Pass.

In addition to these discovered passes, the Northern Kutanie Pass has been laid down, and found to be entirely within the British territory, and I have named this the British Kutanie Pass.

With regard to the expressed wish of Her Majesty's Government that I should communicate with Captain Hawkins, I beg to state that I shall endeavour to find an opportunity of doing so.

In conclusion, I have to acknowledge the receipt of your Lordship's courteous expressions on the subject of my letter of 13th March, 1858. I have also to acknowledge the receipt of the abstract account for the financial year 1857-58.

I have, &c.,

JOHN PALLISER, Capt.,

Commanding N. British American Exploring Expedition.

The Right Hon. LORD STANLEY, M.P.,

&c. &c. &c.

Fort Edmonton, Saskatchewan, October 9, 1858.

SIR,—I have the honour to report the safe arrival of myself and party at this place on 7th current, being exactly eight weeks from the time of our separation from the remainder of the Expedition.

After your departure to the boundary line on August 3, according to your instructions I conducted the Expedition without loss of time to the site of the Old Bow Fort, and arrived there on the afternoon of the 7th. On the 5th we began to ascend considerably, and saw the last of the real plains. From this point our way lay over a succession of parallel ranges of hill, wooded in some parts to their summits, but not rising to more than 800 or 1000 feet above the plain. On the morning of the 7th we first struck the south branch of the Saskatchewan at the mouth of Dead Man River, and from this point we

followed it up until we reached the Old Fort on the same day. Its site is marked only by a group of mud and stone chimneys, the remainder of the fort having been constructed of timber, all of which has long ago been removed and used by the Indians as firewood. A small stream joins the river from the west at this place, and the main stream itself makes a bend from a north to an easterly course.

Our camp was pitched within three miles of the mountains, which rose behind as ranges of bald, inaccessible cliffs to the height of from 3,000 to 4,000 feet above the eye.

We fortunately met with a large camp of Assiniboines at this place, from whom I traded pack saddles and other articles which were required for our mountain work.

In conjunction with Lieut. Blakiston, observations were made on the temperature of boiling water, to determine the altitude of the place, and to find the errors of our aneroids. The corrected mean readings for the time of our stay compared with the mean for Carlton showed the altitude above that place to be 2,225 feet, or above the sea 4,100 feet. Our aneroids, and also the sympiesometer for great altitudes, I am glad to say, still gave a very close approximation to true readings, notwithstanding the great increase of elevation.

On 11th August M. Bourgeau and I started and camped together about 11 miles up the valley of Bow River, on the banks of a lake formed by a dilatation of the river in consequence of the valley being barred by immense deposits of rounded shingle. Our road was rather a bad one, on account of the fallen timber which impeded our path, the valley not having been frequented by the Indians for many years.

This first portion of the valley cuts through five parallel ranges of mountains at right angles to their axes. These are composed of beds of crystalline and compact fossiliferous limestone (most likely of carboniferous age) dipping at 30° to w.s.w., but having several obscure plications. Two well-marked peaks occur on either side of the valley, which M. Bourgeau named "Grotto" and "Pigeon" peaks.

After passing the former of these, the following morning (having taken leave of M. Bourgeau, who remained to examine this mountain) I entered a wide trough-like valley, running to s.s.e., through which I contrived to follow up Bow River in the opposite direction for three days. This trough continues to run through the mountains, beyond the points where the river leaves and enters it, the latter being between "Cascade" and "Bundle" Mountains.

"Cascade" Mount, which is known to the Indians as the "place where the water falls," rises as a series of precipices to the height of 4,521 feet above a small level plain at its base, and is so abrupt that its summit is in view at a horizontal distance of 2,200 yards. It may be taken as a type of the mountains in this portion of the chain, all being equally precipitous and inaccessible.

Bounding the valley to the south is the "Windy" Mount of M. Bourgeau, which he has made the subject of an elaborate botanical examination.

From the Cascade Mount the river valley again changes its direction, passing at right angles to the chain so as to cross the "Saw-back" range, which are composed of the same strata as before, but now almost vertical, having only a slight inclination to w.s.w.

After following up the valley which then was reached, to w.w. for three days, on the 18th I arrived at "Castle" Mount, opposite the entrance to the "Vermilion" Pass. I had already passed three small tributaries, by following up either of which the height of land can be crossed to the Kutanie River, but judging from Indian report, none of these were so promising as this one, by which I now resolved to cross the water-line of the mountains.

The mountains now began to wear a different aspect, more massive, and evidently much loftier. They are composed of white and pink quartzose sand-

stone, almost passing into a quartzite in some parts, and in others into a fine conglomerate. Their minute description, as well as other geological points, will, however, form the subject of a more special report.

Having devoted a day to the examination of Castle Mount, and to prepare the flesh of a moose we had killed, on the 20th I crossed Bow River, without swimming the horses and unloading their packs; and, after a six hours' march through thick woods, reached the height of land the same afternoon.

By careful barometric readings I found the rise from the river to be 539 feet; and I consider the rise of the river, to where I crossed it from the Old Bow Fort camp, to be 300 feet, thus giving for the height of land 940 feet. The small stream along which we had ascended here ends in two small lakes, the water of which is beautifully clear; and 200 yards farther on, and at 17 feet above the level of the upper lake, we came on a rapid turbid stream, flowing to the s.w., which was the head of the Vermilion River, the principal branch of the Kutanie River.

The height of land is in $51^{\circ} 8' 30''$ n., longitude by account $116^{\circ} 35'$ w. It is in a wide valley, between outlying shoulders of two snow-clad mountains, which I named after Mr. Ball and Colonel Lefroy, the latter being to the west. The ascent to the watershed from the Saskatchewan is hardly perceptible to the traveller, who is prepared for a tremendous climb by which to reach the dividing ridge of the Rocky Mountains, and no labour would be required, except that of hewing timber to construct an easy road for carts, by which it might be attained.

The three following days were occupied in the descent of Vermilion River, which, after flowing to s.w. by w. for nine miles, suddenly changes its course to s.e. for 18 miles, when it again changes to s., escaping into a wide valley to join a much smaller stream, which is the Kutanie River.

In its course of about 40 miles it descends 1,227 feet, so that at its junction with the main stream it is 383 feet below the Old Fort.

It becomes of considerable size a very short way from its source, as it receives large tributaries from glaciers which occupy the valleys of Mounts Lefroy, Ball, and Goodsir. The valley through which it flows is contracted only at one point, "The Gorge," near its lower part, where two lofty mountains seem to close in on the stream, without, however, in reality causing any great difficulty in passing along its base.

A road for carts down the valley of Vermilion River, from the height of land to the Kutanie River, could be cleared without difficulty; for, supposing the road to follow a straight line along the river, and the descent to be uniform, which it almost is, the incline would only be 40 feet in a mile, or 1 in 135.

The absence of any abrupt steps, either in the ascent or descent, together with the small altitude to be passed over, form very favourable points in the consideration of this pass as a line of route.

There is some confusion as to which is called the Vermilion and which the Kutanie River, in the accounts given by Indians, so I have thought it better to confine the former name to the large stream by which I descended, and consider the smaller stream into which it flows as the Kutanie River. This accords better with the nature of the valleys, as the Kutanie River, although an insignificant stream before receiving the Vermilion River, flows s.e. through a magnificent valley from three to five miles in breadth.

The forks of Kutanie and Vermilion River are in lat. $50^{\circ} 50'$ n., long. by account $116^{\circ} 40'$ w. (I may state that, in reference to all my longitudes, I did not trust to the reckoning by distances travelled alone, but obtained them by a system of bearings, combined with numerous observations for latitude.)

I should have liked very much to have descended the Kutanie River for some distance, to find if there is any gap in its valley by which a passage could be effected to the west without following down the stream; but my orders to

confine myself to the water-line of the mountains, and which required me to be back at Fort Edmonton early in October, limited me to a less extended circuit in the mountains than I should then have required to make; besides, judging from the absence of all tracks since leaving the valley of the south branch, there did not seem to be the slightest prospect of procuring game on the west side of the watershed, and we were now beginning to be pinched for provisions.

Ascending the Kutanie River, therefore, on the 27th, I reached the height of land which divides it from one of the principal tributaries of the Columbia River, called Beaver Foot River. The watershed is in a large morass, with several lakes occupying the bottom of a deep wide valley, common to the two streams, although flowing in opposite directions. The line of watershed is so little marked that it is impossible to cross even on foot between the two streams without going in water. On either side of it the stream is dilated into wide shallow lakes, the surfaces of which were crowded with the gaudy flower of the Nuphar lutea. The altitude of this watershed I considered to be 3,834 feet above the sea, or 266 feet below the Old Fort.

It is on the 51st parallel of latitude, in longitude $117^{\circ} 10'$ w. On the north side of the valley are Mount Goodsir and Pyramid Mountain, and on the south is the Brisco range, which, although of no great elevation (about 2,000 feet above the eye), run, as an unbroken wall, to s.s.e. My Indian declared that the river we had now struck was the head of the north branch of the Saskatchewan, and wished to follow it down; but if my barometer and sympiesometer were acting with any approach to accuracy, we were now about on a level with what I had found to be the elevation of the Mountain House during last winter, so that this could not be the case. In addition, the change in the vegetation, especially the occurrence of cedar, convinced me that we were really on a branch of the Columbia.

I accordingly only followed it for two days, and on the 29th reached the mouth of a large tributary, to n.w. This river is much larger than the Vermilion River, and about four times the size of the stream into which it flows, being about equal to the south branch at the point where we left it.

Here I received a severe kick in the chest from my horse, rendering me senseless, and disabling me for some time. My recovery might have been much more tedious than it was, but for the fact that we were now starving, and I found it absolutely necessary to push on after two days.

Where it receives Beaver Foot River, Kicking Horse River bends back on itself, including an angle of only 20° , and after passing over a fine fall of about 40 feet flows on to s.w.

The mouth of Beaver Foot River is about 318 feet below the height of land where we first struck it.

As I was quite unable to move, I sent my interpreter, Peter Erasmus, to ascend Mount Hunter, which is included in the angle of Kicking Horse River. He ascended for 3,496 feet, and obtained a view, to the west, of snow-clad peaks as far as the eye can reach. Over the tops of Brisco's range, and all to the left of s.w., he could perceive no mountains; so that if that portion of country is occupied by any, they must be of very inferior altitude.

It was my intention to have crossed Brisco range on foot, but my unfortunate accident quite unfitted me for the task.

The angle of Kicking Horse River is in lat. $51^{\circ} 10'$ n., long. $117^{\circ} 26'$ w.

While traversing this valley, since coming on the Kutanie River, we have had no trail to follow, and it did not seem to have been frequented by Indians for many years. This makes the absence of game all the more extraordinary. The only animal which seemed to occur at all was the panther. The Indian saw one, and in the evenings we heard them calling, as they skirted round our camp, attracted by the scent.

The bottom of the valley is occupied by so much morass, that we were obliged to keep along the slope, although the fallen timber rendered it very tedious work, and severe for our poor horses, that now had their legs covered by cuts and bruises.

The timber along Beaver Foot River is mostly young, but there are the remains of what had been a noble growth of forests, consisting of cedar, pines, and spruce, among the latter of which is the magnificent prusche, which sometimes reaches four yards in circumference. I also saw a few young maples (*Negundo fraso*). Berries of many kinds were very abundant; and, indeed, had it not been for these, we should have suffered much from hunger.

On 31st August we struck up the valley of Kicking Horse River, travelling as fast as we could get our jaded horses to go, and as I could hear the motion, and on the 2nd Sept. reached the height of land. In doing so we ascended 2,021 feet. Unlike the Vermilion River, the Kicking Horse River, although rapid, descends more by a succession of falls than by a gradual slope. Just before we attained the height of land, we ascended more than 1,000 feet in about a mile, down which the stream leaps by a succession of cascades.

This height of land is 5,120 feet above the sea, and is in lat. $51^{\circ} 24' N.$, long. $117^{\circ} 20' W.$ The waterline is in a flat valley, clothed with fine open forests of spruce, lying between Mount Vaux and the eastern end of the Waputteehk Mountains.

Here, to our great joy, we found tracks of game again.

On the morning of the 3rd we followed down a small stream over a wooded plain for about six miles, and only descended about 50 feet from the height of land, when we came to a large river, flowing to S.E., which the Indian at once recognized as the south branch, from which we had been absent about two weeks.

The same afternoon he killed a moose, which relieved us from want, and we also fell in with a band of Assineboines, who had just come over by a direct pass from the north branch to this place.

We had several days of severe weather at this time; a great deal of snow with thunderstorms. I delayed here with the Indians on account of our horses requiring rest, and also to get them to dry our moose-meat properly for us, as we lost more than half of the last from its not being well prepared.

On 8th September I started to ascend the south branch, not following the pass by which the Indians had come, and which they described as very easy, but to endeavour to pass from its head waters to those of the west branch.

All the mountains on both sides of us were now snow-clad; those on the south side leaving their valleys occupied by glaciers, some of great size.

In two days we reached the height of land by a gradual ascent. Here the south branch issues from a lake about four miles long, the upper end of which is fed by a glacier which descends from a magnificent *mer de glace*, occupying the elevated valleys of Mount Balsour. There is a small stream, however, which flows into this lake from a fine plain which forms the upper of the valley. Following up this, we come to where it rises from a group of springs, and a few yards farther on, a second group gives rise to the waters of the north branch. We dined at this watershed, which is the highest point we passed over with the loaded horses, being 6,347 feet above the sea. Snow was lying under the shade of the trees, notwithstanding the clear midday sun. Lat. $51^{\circ} 40' N.$, long. $117^{\circ} 30' W.$

The first part of the descent from this height of land was a great contrast to our ascent of the south branch to reach it; for, in the course of two miles, we had descended about 1,000 feet. Four miles from the height of land, the small stream which originates there receives a large branch from S.E., which rises in a glacier, descending from the same *mer de glace* as that which feeds the lake at the head of the south branch. This feeder of the north branch I called

the Little Fork: it flows to n.w. through a rugged valley between Mount Murchison and Mount Balfour. The former of these, which is a most massive mountain, the Indians consider to be the highest of all the Rocky Mountains.

I afterwards measured two of its highest peaks, the one above the angle of the main river and the little fork, the other to the south of the Kutanie plain, on the main river. They are, respectively, 15,780 and 14,431 feet above the sea. I hope I may have yet an opportunity of visiting Mount Brown and Mount Hooker, so as to obtain their altitudes relatively to Mount Murchison. The great size of these mountains, some of which are formed of groups 60 to 80 miles in circumference, prevents the proper appreciation of their altitude; besides, not only here, but all through that portion of the range I have seen, there is an absence of striking peaks.

From the point where I met the north branch, I ascended to the place known to the Indians as the "Ice," and from which the largest fork of the north branch rises. The river is large at this place, and flows through a very wide valley, winding through shingle beds which must be covered by every spring flood, as they are clothed by a matting of *Dryas integrifolium*, *Epilobium alpinum*, and other Alpine plants, the seeds of which have been carried down from their natural habitats by the mountain torrents.

It occupied two days to ascend to the foot of the great glacier; but one of these was occupied in cutting a road through fallen timber along the banks of the Glacier Lake. This lake is about seven or eight miles long, and about four wide, and is formed by the damming up of a narrow valley between Mount Forbes and Mount Lyell.

The upper part of this valley is occupied by glaciers communicating with immense fields of ice which cover the mountains all round it. The foot of the glacier is about 4,320 feet above the sea. It is easy of ascent, as it terminates by a rounded slope, to reach which, from the floor of the valley, I had only to scramble over the series of moraines which lie in front of it. That portion lying within the valley is about five miles long and three wide; it is 600 feet deep at its lower part, but its surface at the upper end is 1,560 above the valley at its base. It is fed by a narrow spout-like glacier from the *mer de glace* above. I ascended Sullivan Peak, to the north of it, having an altitude of 7,858 feet, and obtained a splendid view of the immense mass of ice which envelops the mountains to the south and west, obliterating all their valleys.

The stream which issues from the Glacier Lake is much larger than either the main fork or the little fork. The former of these two I ascended for some distance, and saw that it took its rise in the glaciers of a mountain to s.s.e. Up this river there is said to be a pass direct to the Columbia, which was the one first used by trappers in the time of the North-West Company, as far as I could make out from the accounts of the Indians. Mount Forbes, which lies between the Glacier Lake and the great fork of the north branch, I found to have an altitude of 13,400 feet.

Descending the valley of the north branch as it sweeps round the base of Mount Murchison, on the 16th I reached the Kutanie plain, where the valley becomes much expanded, and is occupied by fine level plain, free from wood, like true prairie. This spot is famous among the Indians for the abundance of game, but it had been well hunted during the summer, so that there was now none left. Buffalo at one time were very numerous here, and their bones and dung showed that this must have been not many years ago. I remained here a few days to examine the mountains which overlook the valley. One to the west of the plain I ascended, and found to be 8,913 feet above the sea. On the east side of the valley is what I consider to be the continuation of the Saw-back range; so that the Kutanie plain lies in the same trough-like valley of the mountains as that in which Castle Mountain stands, and which is continuous to the north-east of Mounts Richardson and Murchison.

While resting here the Indian shot some of the big horns, the meat of which,

when fat, is certainly the finest of all animals in the country. They occur only along the outer range of the mountains. The rams alone frequent the high portions of them, and the ewes keep by the river margins, especially where craggy. The true animal of the mountains is the white goat, which always keeps at high altitudes, and is only met with toward the axis of the chain. It never descends into the valleys, summer or winter, except at certain places, to eat a kind of white clay, which occurs among the recent deposits in the valleys of the mountains.

The valley of the north branch cuts through the mountains more directly than that of the south branch, and is accordingly much shorter.

Throughout it is very much wider than the valley of any other river I have seen in the mountains, and it is skirted by terrace levels consisting of deposits of shingle, white calcareous clay, and sand, the whole way up to the great fork. Its descent is not great, amounting only to 300 feet from the glacier lake to where it issues from the mountains. Having passed a large tributary from the north, which I named Waputteehek or "White Goat" River, I passed out of the mountains on the afternoon of the 18th, after having been 38 days travelling in them. The following day we arrived at Big Horn River, where I determined to give my horses a week's rest, as they were so reduced as to be quite unfit for the long trip which still remained before reaching Edmonton. The feeding along this tributary of the Saskatchewan which enters it between the main chain and Brazeau range is exceedingly fine, consisting almost entirely of vetches. Besides, I wished to get a series of observations for chronometer rate, so as to determine, if possible, the exact longitude of this place, and by comparing that with the longitude of Bow Fort, obtain the direction of this portion of the chain, as the two places occupy similar positions with reference to it. The latitude of the point where the north branch leaves the mountains is $52^{\circ} 20' N$. The longitude I have not yet ascertained, but by account $117^{\circ} W$.

While resting at this place, the Indian killed several ewes of the big horn, the flesh of which we dried to serve as provision to take us to Edmonton. Here we were met by a band of Assineboines, who came and camped beside us, and from whom I obtained a fresh horse for one that was too much reduced to proceed farther. The weather was again very unsettled at this time, and several inches of snow fell, which continued to lie on the mountains. We started for the Rocky Mountain House on the 27th, and, leaving the north branch to the south, passed through a nick in Brazeau range. This range is formed of limestone beds tilted up at an angle of 30° to W . They are wooded to their summits on the west side, and rise to about 2,000 feet above the valley.

Having again met the north branch, we followed it down through thick forests, till, on the night of the 31st, we reached the Mountain Fort in lat. $51^{\circ} 28' N$, long. $115^{\circ} 7' W$. The fort is deserted all summer, being only a winter post for the Blackfeet. The traders had not yet arrived, so we found it looking very desolate, with the courtyards choked with weeds, and all the windows and doors were standing open. We took possession of it for the two nights we were at this place, but did not find it so comfortable as our camp fire.

On 2nd October I left the Mountain House for Edmonton, following the road I had travelled between the two places last winter. We were again out of provisions; but as we were now travelling among poplars, we had no difficulty in supporting ourselves on rabbits.

A severe snow storm, which covered the ground to the depth of 18 inches, quite fatigued our horses, so that we had to load our riding horses; and in this manner only with difficulty reached this place on the 7th.

I remain, &c.,

Capt. JOHN PALLISER, &c. &c.

JAMES HECTOR, M.D.

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OBSERVATIONS for LATITUDE made by Dr. HECTOR when detached from the Expedition.

Date.	Place.	Obs. Mer. Alt. corrected for I.E.	Longitude by Account.	Latitude.
1837.				
Dec. 14	Four miles E. of Redberry Lake	* Polaris 108 20 0	106 56 0	52 42 0
" 19	English Creek	108 13 0	108 56 0	53 16 0
" 19	E. angle of Red Deer Hill	* Polaris 110 53 0	109 3 0	53 28 0
" 20	Fort Pitt	* 110 4 30	109 18 0	53 35 0
" 20	"	* Jupiter 97 46 0		53 34 0
" 22	"	96 32 0		53 24 0
1858.				
Mar. 29	Fort Pitt	79 20 30		53 34 0
Jan. 5	Fort Edmonton	28 26 0	113 49 0	53 29 0
" 5	"	* Polaris 109 50 0		53 30 0
" 8	"	28 0 0		53 22 0
Feb. 10	"	44 2 0		53 30 0
" 11	"	44 42 0		53 30 0
" 20	"	50 51 30		53 31 0
Mar. 4	"	59 51 0		53 31 0
" 6	"	61 26 30		53 30 0
" 7	"	62 9 30		53 31 0
Jan. 11	Crossing Place, Battle River, on Moun- tain Ho. Track	* Jupiter 99 34 0	114 6 0	52 41 0
" 14	Rocky Mountain Fort	* Polaris 107 53 0	115 30 0	52 29 0
July 9	Elbow of Battle River	119 37 0	111 5 0	52 19 0
Aug. 12	Rocky Mountains, Bow River, First Lakes	107 19 30	115 16 0	51 1 44
" 14	Rocky Mountains, Bow River, The Nick	103 59 0	115 30 0	51 2 26
" 15	Rocky Mountains, Bow River, Cascade Mount	103 10 0	115 40 0	51 9 18
" 18	Rocky Mountains, Bow River, Castle Mount	103 10 0	116 0 0	51 10 42
" 21	Rocky Mountains, Vermilion River, The Angle	101 20 0	116 26 0	51 6 0
" 22	Rocky Mountains, Vermilion River, Snow Creek, S. from Mount Ball	100 49 0	116 19 0	51 2 45
" 24	Rocky Mountains, Kutania River, N. of Forks	99 48 0	116 26 0	50 52 0
" 26	Rocky Mountains, Kutania River, its source	98 11 0	116 40 0	51 0 37
" 28	Rocky Mountains, Beaver Foot River	96 28 30	116 52 0	51 9 30
" 30	Rocky Mountains, Kicking Horse River Falls	95 0 0	116 55 0	51 10 0
Sept. 1	Rocky Mountains, Kicking Horse River Falls	93 18 0	116 57 0	51 16 30
" 3	Rocky Mountains, Bow River, Noore Creek	91 38 0	116 38 0	51 22 40
" 8	Rocky Mountains, Bow River, Noore Creek	87 44 0	116 43 0	51 23 0
" 9	Rocky Mountains, Bow River, its source	86 34 0	117 0 0	51 40 0
" 11	Rocky Mountains, N.B. Saskatchewan, E. end of Glacier Lake	86 46 0	117 30 0	51 54 0
" 12	Rocky Mountains, N.B. Saskatchewan, W. end of Glacier Lake	83 54 0	117 30 0	51 52 16
" 14	Rocky Mountains, N.B. Saskatchewan, 4 miles above mouth of Little Fork	82 16 0	117 30 0	51 56 30
" 18	Rocky Mountains, N.B. Saskatchewan, 4 miles below Wapattuk River	78 45 30	116 46 0	52 18 0
" 20	Rocky Mountains, N.B. Saskatchewan, Sheep River	76 41 0	116 40 0	52 24 0
" 23	Rocky Mountains, N.B. Saskatchewan, Sheep River	74 21 0		52 23 30
" 28	Saskatchewan River, N.B. Miry Creek	70 14 0	116 10 0	52 30 0
" 29	N. branch Saskatchewan	69 35 30	116 0 0	52 26 0
Oct. 1	S.E. of Mountain, in woods	67 20 30	115 25 0	52 23 30
" 5	Bad Bearer Dam	42 59 30	113 58 0	53 5 0
Nov. 29	Battle River, Bear Hill	30 55 0	115 55 0	52 46 26
Dec. 1	Red Deer River, mouth of Blad River	31 10 0	115 0 0	52 18 13
" 2	" 10 miles above last	31 6 0	115 30 0	52 12 36
" 4	Red Deer River, 5 miles above Medicine River	30 55 0	114 20 0	52 1 26
" 6	Red Deer River, 20 miles above last	30 47 0	114 40 0	51 50 23
" 9	Little Red Deer River	30 52 0	114 45 0	51 29 28
" 10	" source of	30 55 0	114 50 0	51 21 40
" 15	Edge of Plain, Stony Camp	30 7 0	114 45 0	51 25 24

RECORD of ASTRONOMICAL OBSERVATIONS during Seasons 1857-58.

Longitudes obtained by Observation.

Locality.	Latitude by Observation or by Account.	Approximate M. T. P.	Mean of Chronometer Times corrected for E. on G.M.T.	Mean of Observation Altitudes, corrected for.	Longitude.
	° N. "		D. H. M. S.	° ' "	° W. "
Fort William, H.B.C.	48 24 5	June 13, 8 A.M.	13 1 43 39	68 44 7	89 24 50
Trembling Portage	48 30 0	" 21, 9 A.M.	21 2 47 35	83 45 41	89 58 48
Dog Portage (W. end)	48 45 0	" 22, 9 A.M.	22 2 31 53	83 39 51	89 53 45
Dog River (r. bank)	48 55 0	" 23, 8 A.M.	23 2 16 59	78 30 39	89 53 45
Savannah Portage	48 53 0	" 25, 8 A.M.	25 2 7 17	74 43 35	90 13 46
Barrier Portage	48 45 0	" 26, 5 P.M.	26 10 34 15	64 2 23	90 50 24
French Portage	48 40 0	" 27, 10 A.M.	27 4 4 33	109 19 37	91 11 32
Camp Portage	48 25 0	" 29, 7 P.M.	29 13 24 48	11 48 20	92 27 28
	48 27 0	" 30, 7 A.M.	30 1 13 58	53 12 49	92 30 4
Fort Frances, H.B.C.	48 36 15	July 1, 6 P.M.	1 11 55 8	40 59 27	93 33 33
Italy River	48 50 0	" 3, 9 A.M.	3 3 43 36	99 18 31	94 14 19
Portage de Bots	49 26 0	" 4, 9 A.M.	4 2 42 42	75 36 39	94 48 7
Winipeg River	49 55 0	" 5, 8 A.M.	5 3 2 4	84 34 31	94 45 30
Ditto	50 15 0	" 6, 8 A.M.	6 2 55 52	81 31 54	93 17 19
* Winipeg Lake	50 33 48	" *	" *	" *	98 33 56
Ditto	50 23 0	" 11, 8 A.M.	11 2 35 26	72 21 2	96 30 25
Upper Fort Garry	49 52 6	" 16, 8 A.M.	16 2 47 47	74 49 20	96 52 27
Post on boundary line, near Pembina	48 59 12	" 25, 3 P.M.	25 10 15 1	73 43 58	96 46 13
Prairie	48 52 0	" 28, 3 P.M.	28 10 39 34	65 34 4	97 17 29
Ditto	49 10 0	" 31, 4 P.M.	31 11 5 27	56 51 56	98 10 39
Ditto	49 8 0	Aug. 2, 4 P.M.	2 10 3 51	76 23 2	98 33 45
Ditto	49 8 0	" 3, 5 P.M.	3 11 6 37	56 18 32	98 47 15
Ditto	49 8 0	" 4, 8 A.M.	4 1 43 38	45 42 32	98 43 24
Ditto	49 0 32	" 5, 4 P.M.	4 10 31 20	67 37 43	99 1 25
Turtle Mount, E. Flk.	49 0 0	" 5, 5 P.M.	5 11 46 16	43 6 52	99 16 50
Ditto	49 6 0	" 7, 5 P.M.	7 11 21 48	50 23 27	99 21 43
Qu'Appelle Lakes, 12 miles S. of	50 20 0	Sept. 13, 3 P.M.	13 10 26 33	49 31 28	103 45 45
Saskatchewan, S. branch of	50 52 49	" 27, 3 P.M.	27 11 32 31	25 19 17	107 41 7
Red Deer Lakes, 6 miles N. of	51 20 0	Oct. 3, 9 A.M.	3 3 43 15	20 27 9	107 32 15
Prairie	51 43 0	" 4, 9 A.M.	4 4 44 59	26 43 30	107 37 51
Ditto	52 5 0	" 5, 2 P.M.	5 9 28 40	24 18 40	107 21 0
Ditto	52 12 0	" 6, 2 P.M.	6 9 43 4	22 11 31	106 51 0
1858.					
Eagle Hills	52 18 0	June 21, 7 A.M.	21 2 9 22	96 52 33	107 28 15
Ditto, 3 miles S. of Lizard Lake	" "	" 21, 4 P.M.	21 11 30 33.5	33 23 19	107 28 16
Eagle Hills, at Stony Lake	52 14 0	" 22, 3 P.M.	22 9 46 39	48 40 29	107 35 4
Prairie	52 14 0	" 23, 9 A.M.	23 3 15 19.4	42 22 11	108 11 33
Ditto	52 16 0	" 24, 7 A.M.	24 2 8 16.4	25 39 17	108 27 27
Ditto	52 21 0	" 25, 7 A.M.	25 2 30 14.6	29 7 5	103 44 25
Wiquatinow, Valley of	52 28 39	" 26, 8 A.M.	26 3 49 47	40 54 2	108 51 39
Ditto ditto	52 28 39	" 27, 8 A.M.	27 3 50 43	41 1 6	108 52 36
Prairie	52 30 0	July 2, 4 P.M.	2 11 20 15	35 53 22	109 2 30
α Ditto	52 34 25	" 4, 8 A.M.	4 3 28 5	36 46 25	109 23 45
Ditto	52 36 0	" 8, 7 A.M.	8 2 32 18.5	27 27 4	110 23 45
Battle River, 1st crossing of	52 35 39	" 7, 9 A.M.	7 4 12 44.7	42 9 5	110 50 7
Ditto 2nd crossing of	51 28 23	" 10, 7 A.M.	10 2 55 48.6	30 4 31	111 29 45
α Dried Mount Camp	52 24 29	" 14, 4 P.M.	14 11 47 15.6	32 59 22	112 14 35

* This observation was accidentally cleaned from slate, leaving, however, the result as tabulated.

α Indicates lunar distances observed.

N.B. Frequent examinations of chronometer rate, since the date of the last tabulated longitude, showed us that the rate was unsteady. All longitudes that are determined since that, are the results of lunar distances.

The longitude of Carlton is the result of the accompanying distances, observed while we remained there.

RECORD OF ASTRONOMICAL OBSERVATIONS, &c.—continued.

Latitudes by Observation.

Locality.	Date.	Observed Mean Altitude, Corrected for Index Error.			Longitude by Observation or by Account.			Latitude.		
		°	'	"	°	'	"	°	'	"
Fort William, H.B.C.	1857. June 13	129	11	16	89	24	50	48	34	5
Dog Lake (S. shore)	" 22	128	51	97	89	45	0	48	46	11
Prairie Portage	" 24	128	27	37	89	45	0	48	56	16
Fort Frances, H.B.C.	July 1	128	28	41	93	33	33	48	36	15
La Pluie River	" 2	128	29	21	93	50	0	48	47	18
Lac de Bois	" 4	126	4	53	94	48	0	49	33	45
Winnipeg River	" 6	134	6	1	95	20	0	50	21	38
Lake Winnipeg	" 10	122	45	51	96	33	56	50	33	46
Upper Fort Garry	" 16	123	19	28	96	52	27	49	52	6
Prairie	" 22	120	56	52	97	0	0	49	28	43
Post on Boundary Line near Pembina	" 25	120	40	22	96	46	13	48	59	12
Prairie	Aug. 1	117	4	14	97	56	0	49	6	53
Ditto	" 2	116	33	54	98	20	0	49	7	47
Ditto	" 4	115	36	50	98	50	0	49	4	40
Turtle Mount, E. Falkland	" 5	115	12	37	99	16	50	49	0	32
Ditto	" 7	113	54	47	99	21	43	49	6	3
Prairie	" 12	109	59	37	100	5	0	49	36	3
Ditto	" 14	107	49	17	101	10	0	50	4	20
α Fort Ellice, H.B.C.	" 17	105	15	0	101	48	0	50	24	32
Ditto	" 21	102	37	40	101	48	0	50	24	24
Prairie	Sept. 11	87	28	35	102	10	0	50	23	40
Ditto	" 18	81	59	55	106	0	0	50	27	59
Ditto	" 19	81	9	45	106	50	0	50	44	45
Ditto	" 20	79	50	55	107	10	0	50	44	45
α Saskatchewan, Elbow of S. Branch	" 22	77	42	7	107	37	30	51	1	24
Saskatchewan, S. Branch of	" 27	74	5	7	107	41	7	50	52	48
Red Deer Lakes, 6 miles N. of	Oct. 3	68	23	47	107	32	0	51	23	45
Prairie	" 4	66	54	27	107	32	0	51	45	16
Ditto	" 5	65	32	27	107	0	0	52	3	7
Ditto	" 7	63	3	27	106	30	0	52	31	40
Jack Fish Lake	" 23	50	56	37	108	10	0	53	2	6
1858.										
Eagle Hills	June 21	121	48	35	107	28	15	52	17	59
Prairie	" 23	121	53	35	108	11	33	52	14	37
Wiquatinow, Valley of	" 26	121	16	45	108	52	10	52	28	39
α Sand Hills	July 4	120	5	20	109	22	0	52	34	25
Battle River, 1st crossing of	" 8	119	14	30	110	50	7	52	36	39
Ditto 2nd ditto	" 10	118	59	45	111	29	45	53	28	23
α *Dried Meat Camp	" 14	118	0	5	112	18	45	53	24	29
Bull Lake, 3 miles S.E. of	" 18	116	42	55	112	34	0	52	23	24
Dead Man's Creek	" 20	116	6	45	113	3	0	52	19	25
Nick Hills	" 23	115	8	45	113	40	0	52	12	52
Camp	" 24	115	18	0	114	0	0	51	55	43
α *Cabe Camp, Edge of the Woods	" 26	114	31	40	114	10	15	51	58	52
Prairie	Aug. 1	112	47	53	113	55	0	51	19	12
α Slaughter Camp	" 2	112	14	5	113	50	0	51	20	47
Bow River, 1st crossing of	" 4	112	3	55	113	50	0	50	54	46
Most N. Tributary of Belly River, 1st crossing of	" 6	112	34	30	113	45	0	50	6	23
Tributary of Belly River, 1st crossing of	" 7	113	9	5	113	53	0	49	32	31
Chief's Mountain, 6 miles N. of	" 8	113	29	35	113	50	0	49	5	6
Tributary of Belly River, 2nd crossing	" 10	111	32	35	113	58	0	49	33	50
* Woods	" 13	106	56	25	114	20	0	50	52	49
α *Old Bow Fort, Site of	" 15	105	10	20	115	4	30	51	8	46
Kananaski Pass in Rocky Mountains	" 19	103	5	25	115	12	0	50	54	17
Ditto	" 20	102	44	25	115	12	0	50	45	3
Ditto	" 21	102	20	35	115	21	0	50	37	1
Ditto	" 22	101	38	45	115	21	0	50	37	49
Ditto	" 23	100	55	55	115	27	0	50	38	55

RECORD of ASTRONOMICAL OBSERVATIONS, &c.—*continued.**Latitudes—continued.*

Locality.	Date.	Observed Mean Altitude, Corrected for Index Error.			Longitude by Observation or by Account.			Latitude.		
		°	'	"	°	'	"	°	'	"
	1858.	O			W.			N.		
Tributary of Kutania River	Aug. 24	100	32	15	115	30	0	50	30	14
Forks, Kutania River	" 26	99	14	50	115	43	0	50	27	21
Kutania River	" 27	98	48	40	115	40	0	50	19	24
Ditto	" 28	98	24	40	115	42	45	50	10	13
Ditto	" 29	98	0	0	115	33	0	50	1	14
Tobacco Plain, commencement of	" 30	96	54	25	115	33	0	49	42	41
α Stray Camp	Sept. 9	95	12	55	115	27	0	49	58	15
British Kutania Pass, W. end of	" 6	93	49	5	115	22	0	49	11	21
Ditto ditto Height of Land	" 7	92	47	25	114	58	0	49	19	44
Ditto ditto E. end of	" 9	90	52	15	114	30	0	49	32	3
Middle Tributary of Belly River, coming from Crow Lodge	" 10	89	44	25	114	25	0	49	47	0
Most N. Tributary of Belly River, 2nd crossing of	" 11	88	0	40	114	21	0	50	12	16
High Wood River, 4 miles N. of	" 12	86	23	30	114	18	0	50	35	29
Bow River, 7 miles S. of	" 13	84	59	0	114	10	0	50	57	16
*Red Deer River	"	Obser. of Polaris			114	13	0	52	4	45
Battle River, 3rd crossing of	" 18	77	42	25	114	0	0	52	39	44
α *Fort Edmonton	" 22	79	52	40				53	31	43
Ditto	" 24	71	18	41				53	31	44
Ditto	"	Red. to Mer.						53	32	11
Ditto	"	Red. to Mer.						53	31	59
Ditto	"	Mer. Alt. of Moon.						53	32	13

* Indicates Latitude obtained by other methods.

α " " Lunar Distances observed.

N.B.—The Longitude of Edmonton is omitted, as a series of Lunar Distances are being taken for that purpose.

RECORD OF ASTRONOMICAL OBSERVATIONS.

For Variation of the Compass.

Latitude.	Longitude.	Mean of Chronometer Times.	Error on G.M.T.	Mean of Observed Altitudes.	I. E.	Mean of Observed Bearings.	Var.
° N. "	° W. "	D. H. M. S.		° ' "	' "	° ' "	E. "
48 30 0	89 58 48	June 21 2 3 6 55	2 40	94 36 26	+2 27	W. 193 53 N.	6 21
48 45 0	89 53 45	" 22 2 18 42	2 43	By Hr. L.	—	N. 90 26 E.	8 54
48 40 0	89 58 0	" 21 8 50 46	2 40	95 4 52	+2 27	243 54	5 14
48 55 0	89 53 48	" 23 2 20 53	2 45	By Hr. L.	—	91 49	9 5
48 53 0	90 13 46	" 25 2 0 45	2 49	97 23 25	2 27	88 35	6 53
48 45 0	90 50 24	" 26 10 23 45	2 52	97 27 10	—	254 50	3 31
48 35 0	91 12 0	" 27 12 17 22	2 54	30 30 10	—	279 40	8 14
48 25 0	92 27 28	" 29 13 30 23	3 5	By Hr. L.	—	290 38	6 46
48 27 0	92 38 0	" 30 1 16 56	3 8.5	By Hr. L.	—	75 30	9 53
48 36 0	93 33 33	July 1 4 19 9.6	3 9.5	111 1 39	+5 51	118 15	9 31
48 50 0	93 58 0	" 3 3 34 32	3 12	95 25 11	—	101 0	11 20
49 26 0	94 48 0	" 4 3 20 9	3 15	89 6 6	—	98 35	10 17
49 53 0	94 45 30	" 5 5 8 50	3 17	118 2 12	—	129 51	15 47
50 15 0	95 17 19	" 6 3 2 30	3 19	84 29 15	—	91 25	15 7
50 33 0	96 33 56	" 10 10 9 3	3 28	74 26 40	—	244 49	14 41
50 23 0	96 30 0	" 11 2 28 54	3 30	73 33 3	+5 2	84 43	14 9
49 18 0	96 40 0	" 23 2 11 39	13 0	65 35 16	—	85 25	12 3
49 5 0	96 50 0	" 23 7 40 0	13 5	O's sett. amp.	—	288 10	12 12
49 0 0	96 42 28	" 25 10 17 42	14 1	68 19 36	+5 2	246 12	14 2
48 53 0	97 13 44	" 28 10 27 16	14 46	51 17 35	—	248 55	14 37
48 50 0	97 29 48	" 29 11 14 8	15 1	49 6 46	—	W. 342 10 N.	17 48
48 42 0	97 24 0	" 30 9 48 12	15 6	76 23 6	—	333 38	19 8
49 10 0	98 6 39	" 31 11 0 7	15 20	53 20 36	—	N. 249 50 E.	17 4
49 8 0	98 30 4	Aug. 2 9 57 56	15 44	73 7 50	—	W. 324 48 N.	18 32
49 8 0	98 43 80	" 3 10 59 23	15 59	53 9 4	—	337 5	18 41
49 8 0	98 44 39	" 4 1 37 52	16 14	49 13 58	+4 0	164 16	17 52
49 0 32	98 57 40	" 4 9 20 38	16 35	84 5 10	—	315 20	18 24
49 0 32	98 57 40	" 5 11 40 12	16 50	39 20 56	+2 17	W. 343 18 N.	12 0
49 0 0	99 13 0	" 6 2 56 8	16 59	73 16 52	—	W. 178 48 N.	19 44
49 6 0	99 18 0	" 7 11 18 9	17 5	47 51 4	—	338 12	18 58
49 8 0	100 0 0	" 9 9 46 33	17 34	85 34 10	—	307 15	21 49
Ditto.	Ditto.	" 9 9 26 0	—	O's sett. amp.	—	4 30	20 34
50 4 20	100 30 0	" 14 9 10 31	17 49	84 43 46	—	302 32	22 4
50 24 32	101 48 0	" 20 11 5 56	—	48 38 4	—	327 36	21 54
Ditto.	Ditto.	" 21 6 10 51	—	101 38 0	—	238 50	21 28
Ditto.	Ditto.	" 21 10 45 19	—	53 34 56	1 20	324 8	21 14
50 22 0	103 30 0	Sept. 8 9 20 25	—	33 0 15	—	297 35	24 39
51 1 24	107 37 30	" 22 10 29 29	—	47 13 36	4 17	301 0	25 58

RESULT OF LUNAR OBSERVATIONS.

Date.	Place.	Latitude.	Longitude by Lunars.
		° N. "	° W. " ° W. "
Dec. 22, 1857	Fort Carlton	52 52 30	106 8 30
May 19 "	Ditto	Ditto.	106 21 45
" 20 "	Ditto	Ditto.	106 15 39
Sept. 22 "	Elbow, S. branch of Saskatchewan River	51 1 26	107 37 30
Aug. 15, 1858	Old Bow Fort, site of at base of Rocky Mountains	51 9 0	115 8 0
" 16 "	Ditto	Ditto.	115 0 45
			Mean 106 15 18
			Mean 115 4 22

No. 4.

Fort Edmonton, Saskatchewan, January 10, 1859.

MY LORD,—I avail myself of the opportunity afforded by the Hudson Bay Company's Winter Express to send a few lines to your Lordship, although I have nothing of any importance to communicate, owing to the advance of the winter season having put a stop for the present to the farther progress of the Expedition.

Shortly after our arrival at winter quarters here, Dr. Hector started as soon as the snow was sufficiently deep for sleighing, to ascend the Red Deer River, with the object of examining the remainder of a portion of country previously visited last fall. I also started myself in a south-easterly direction to examine the country surrounding Beaver Lake.

I am happy to say that the horses are enduring the severities of the winter very fairly; I have lost but two as yet, and I trust that the rest, with few exceptions, will outlive the winter. They are at present removed about twenty miles from the fort, for fear of being stolen by the Indians; they are guarded by three of my men stationed there, and constantly visited either by my secretary, Mr. Sullivan, or by myself. The horses we ride backward and forward for that purpose are being stabled at the fort.

The fort is built altogether of wood, consisting of one good-sized house two storeys high, inhabited by Mr. Christie, the officer in charge of this post and the Company's traders, and also by ourselves during our stay here. Adjoining this house are the storehouses of the Company, containing their goods and furs, besides the log houses inhabited by the men engaged by the Company, together with their wives and families. The whole is surrounded by wooden pickets or piles, firmly driven into the ground close together, and about 20 feet high.

In shape it is an irregular hexagon, about 100 yards long and 70 wide, and contains a population of about 40 men, 30 women, and 80 children, almost entirely supported on buffalo meat, the hauling of which, for sometimes upwards of 250 miles across the plains, is the source of great and most fruitless expense. Indeed, the labour and the difficulty of providing for a consumption of 700 lbs. of buffalo meat daily, and from so great a distance, would frequently become very precarious, were it not for an abundant supply of fish from Lake St. Ann, about 50 miles to the west of the fort, whence they are capable of hauling 30,000 or 40,000 in a season; these are a fine wholesome white fish, averaging four pounds weight each. Besides this, great quantities of provisions are traded here; it is the principal dépôt for provisions, as the several brigades of boats are most supplied from this place. Few fine furs are traded

here, those which are obtained being chiefly from half-breeds, belonging to a settlement recently made at Lake St. Ann's.

There is a Roman Catholic Mission, under the direction of two French priests, who have induced the half-breeds to cultivate the ground, and sometimes they realize very fair crops of barley and potatoes.

A very little agriculture is feebly carried on about Fort Edmonton, owing partly to the want of acquaintance with even the leading principles of agriculture, and principally from the disinclination of both men and women to work steadily at any agricultural occupation.

I have the honour of enclosing a letter from Dr. Hector on the subject of the geology of that portion of country which was explored last year by the Expedition, also the astronomical observations of last year, which I request may be forwarded to the Geographical Society. I shall reserve my observations, and those of my secretary, Mr. Sullivan, on the longitude of Edmonton until the state of the atmosphere will allow (perhaps) of greater accuracy, for it is important that its longitude should be more accurately ascertained than any one has obtained it hitherto.

I also enclose a separate record of observations taken on the comet, which I will feel much obliged by your Lordship's forwarding to the Astronomical Society.

As I had the honour to communicate my plans and intentions already to your Lordship in my letter of October last, I shall not take up any more of your time.

I have, &c.,

JOHN PALLISER, Captain,

Commanding N.W. British American
Exploring Expedition.

*Her Majesty's Secretary of State
for the Colonies, &c.*

P.S. I am unable as yet to forward the accounts of the present financial year, as they have not yet arrived from Montreal, where they are sent to be priced by Sir George Simpson. J. P.

Fort Edmonton, Saskatchewan, January 10, 1859.

SIR,—I have the honour to make the following report of my geological observations during the past season, in which are embodied only the principal results and general features of the country examined, the details being reserved for a more elaborate study and comparison than can be executed here.

On starting from Fort Carlton on 14th of June, 1858, we crossed the low tract of prairie land which is bounded to the west by that line of high ground which has been traced from longitude 103° w. sweeping to the n.w. to meet the south branch of the Saskatchewan at the elbow, known as the "Coteau des Prairies," and from that point being continued to the north branch as the Bad Hills and Eagle Hills, while across that river it re-appears as the Thickwood

and White Lake Hills. The average elevation of these plains above Carlton (which is built upon the first river level, 35 feet above the water) is 250 feet, or 2125 feet above the level of the sea, and on it rest isolated portions of the higher level which have survived the general denudation, rising as rounded hills from 300 to 400 feet in height, such as Moose Hill on the south branch, and the two Minetonass Hills (Creefor Hill by itself), one of which is opposite to Carlton and the other to Forte à la Corne. These plains are plentifully strewn with erratic blocks of all sizes, being fragments of the rocks of the granitic belt which runs to N.W. from Lake Superior to the Arctic Sea, with others of magnesian limestone and buff-coloured quartzose rock of Silurian age, which crops out all along the western flank of that range. A very remarkable line of the magnesian limestone boulders occurs at the distance of 20 miles above Carlton, crossing the country from the Thickwood Hills in a southerly direction towards the Moose Hills on the south branch.

This limestone contains the same indistinct fossiliferous markings as that at the Stony Hill behind Fort Garry. Some of these masses are of immense size, being made up of portions of several beds which only loosely cohere to form the block. They are all sub-angular, without any glacial markings, although some have their sides highly polished and smoothed from the buffalo rubbing against them. One of these blocks was measured, and computed to be 140 tons.

The nearest known point where this limestone occurs in situ, from whence these blocks may have been derived, is 170 miles distant to N.E.

Disregarding, for the sake of clearness, the order in which the country was examined, I now give at once an account of the whole "drift" phenomena observed.

As we travelled to the west the drift was found to preserve the same mineral character of variable proportions of sand and clay, having boulders interspersed, but chiefly with the clay predominating. The boulders, however, decrease in size, and those of limestone become very rare as the higher plains are gained. At Fort Edmonton, for instance, I found it difficult last winter to procure fragments with which to make lime for medicinal purposes, although the river bed is strewn with those of other rocks. Its depth also becomes much less, forming only a superficial covering to older strata, when observed in the river sections to the west of the Eagle Hills.

As we approached the Rocky Mountains, it quite disappears from the table lands, and is only to be found in depressions of the plain through which streams run, and even the existence of true drift in these places is rendered doubtful, owing to the prevalence of more recent deposits, which have been formed of its re-arranged materials.

At the altitude of 4000 feet above the sea, and at the distance of 50 miles from the mountains, there however occurs a very extraordinary group of blocks of granite, resting upon a high plateau formed of sandstone strata, to be afterwards mentioned. These blocks are of great size, one having been estimated to weigh 250 tons. Although lying miles apart, they seem to consist of the same rock, viz., a mixture of quartz with red felspar, the latter predominating, with only faint traces of mica disseminated in very minute flakes. No granitic rocks have been met with on this side of the watershed of the mountains, and it is not probable that any such exist, at least between the two branches of the Saskatchewan.

These blocks present smooth surfaces, although in general they are rhomboidal in form. Some are cracked into several pieces, which are quite detached, but have evidently at one time formed part of a whole.

If these blocks were derived from the granitic belt to the east, as I believe all the other boulders on the plains to have been, then they must have travelled at least from 400 to 450 miles. From the fact, however, that they are almost on the western verge of the drift deposit, and that the boulders imbedded were

found as a rule to diminish in size in that direction, it may be that the presence of these large blocks is due to very different agencies—different at least in the time of their occurrence.

Close in, along the base of the mountains, neither on the high plateaus nor in the profound valleys by which these are traversed, were there observed any traces of the drift, or its dispersed erratics. Within the outer range of the mountains, which are comparatively low and wooded to their summit, the valleys are occupied by immense deposits of rounded shingle, composed of fragments of the various rocks which have been found to compose the mountains. This shingle, which in some places is loose, and mixed with a large proportion of sand and gravel, in others is cemented by calcareous matter into a solid conglomerate. It fills up the valleys not only along the edge of the mountains, but also right into their interior, forming beautifully marked terrace levels along the streams. This is well exhibited on the north branch of the Saskatchewan, where these deposits skirt its wide valley for nearly 70 miles of its course through the mountains, expanding where it widens so as to form extensive plains, as at the Kutanic plain, and always affording a margin of level ground along the river, rendering the road very practicable.

Towards the upper ends of the valleys the calcareous matter of these deposits so increases as to replace altogether the shingle, when it becomes a fine gritty calcareous mud of glistening whiteness. This same deposit has a much larger development in the valleys on the west side of the watershed, forming terrace levels in exactly the same manner. I observed no shingle beds with it there, however, that apparently being replaced by fine sand and gravel.

In the valley of Bow River there is much less of this calcareous matter in the deposit, it having more of a loose sandy nature, and except at the entrance to the valley in the neighbourhood of the Bow Fort, rarely exhibiting the terrace levels.

In the smaller gorges, where streams come down from the mountains, it is replaced by an angular "breccia," of which patches cling in the most singular positions. This latter deposit is most likely of the nature of glacier moraines, although it is found where no glacier occurs anywhere in the neighbourhood. I found, however, that the glaciers in the chain had, at one time, extended a considerable degree beyond their present limits, and therefore at that time they possibly may have existed in portions of the mountains where now there are none.

The terrace deposits seem to reach pretty nearly the same altitude in different parts of the mountains, viz., about the height of 1000 feet above the level of the plains at their eastern base.

I found that, in crossing the different heights of land, the easiness of the pass corresponded with the degree to which these deposits had remained untouched, owing to peculiarities in the form of the valleys. In the case of every height of land, whether of those examined by Captain Palliser or by myself, with the single exception of the Vermilion pass, the slope is gradual to the east, but to the west the descent is with extreme rapidity. This arises from these deposits having been scooped out close up to the rocky nucleus of the height of land, by currents acting from the western side of the chain, while on the east the erosion has been much more feeble.

How much this may depend on the difference between the width of the valleys which pass through the flanking chains on the east side of the height of land from those on the west, I am not prepared to say, until the nature of the country to the west has been ascertained.

Currents acting on the chain while submerged, would of course be greatly modified in their action by any such differences.

Respecting the age of these deposits I am in doubt. They extend towards the east along the river valleys, at least shingle deposits of the same nature are found at a considerable distance from the mountains, in the valleys of the

north and south branches, and of the Red Deer River. Its relations to the drift have not been distinctly ascertained, as the boulders which mark its presence are only in that district of country found on rounded knolls away from the rivers.

From observations made last summer on the south branch, and during the winter on the north branch of the Saskatchewan, taken with those of this season, I found that the group of sandy clays with crystals of selenite and concretionary nodules of ironstone, which latter contain fragments of cretaceous fossils, extend from the Snake Portage (which is in lat. 54° , and long. $111^{\circ} 30'$ w. nearly) upon the north branch, in a south-south-easterly direction, to the elbow of the south branch, the distance in a straight line between these two places being 240 miles. The north branch, which flows from the Snake Portage to south-east, exhibits in its banks sections of these clays until they disappear under the great depth of drift at the Eagle Hills, thus crossing this formation very obliquely, it forming a strip of not more than 60 miles in breadth; whether this strip be continuous or not cannot be ascertained, as the high plains which lie between the arms of this great river nowhere are cut to a sufficient depth to reach their level.

It is difficult to observe any dip, but I think they must have a slight inclination to north-east. At the Snake Portage these clays are of a clear blue colour, soft, and having selenite crystals in tolerable abundance. At Fort Pitt and at the elbow of the south branch they have much the same character, being of a dark purple brown colour, with the septariæ very frequent, and the selenite only so in some parts. At the Eagle Hills they are not so moist, and form rather a compact shale of a bluish buff colour, much stained with ferruginous streaks; it cracks up into very small fragments with conchoidal surfaces: neither are the septariæ so abundant. This formation here, if dried and hardened, would much resemble the shales observed at Long River, and at Fort Creek on the Assiniboine, during the summer of 1857. A little way above the Snake Portage (which place I again visited this autumn) hills rise above the plain level on both sides of the river to about 300 to 500 feet, such as the Black Hills, Snake Hills, and Egg Lake Hills; these consist of coarse grits formed of pink and green grains with a small amount of calcareous cement, quite the same as those observed in the neighbourhood of the Mountain House. They are in thin beds which weather into spheroidal masses, and between these beds of blue and purple clay are found. It is the same sandstone as is found throughout the Edmonton and Mountain House coal basins, forming the floor upon which they rest.

These basins are divided from each other by a great thickness of buff-coloured sandstone of much the same texture, but not so distinctly bedded, which forms a high ridge crossing the country from Red Deer River at the Nick Hills, by the Musquachis on Battle River to the north branch at Abraham's Gates. At these places it forms lofty precipices, which I think must be similar to those described as the ramparts on the Mackenzie and Peace Rivers.

On Red Deer River, in lat. $52^{\circ} 12' N.$, long. $113^{\circ} W.$, an extensive deposit of coal was discovered associated with the same sands and clays as at Edmonton. The coal forms beds of much greater thickness, however, one group of three beds measuring 20 feet, of which 12 feet were pure coal, the remainder being carbonaceous clays. At one place this coal was on fire, the whole bed exposed in a cliff about 300 yards in length being in a glow, the constant sliding of the bank continuing to supply a fresh surface to the atmosphere. For as long as the Indians remember, this fire had never been extinguished, summer or winter.

A heavy sulphurous and limy smell pervades the air for miles around.

The extent of this coal deposit along Red Deer River is for 14 miles. In

following up the river it is succeeded by the sandstone cliffs, apparently by substitution, as neither the coal group nor the beds of sandstone have any perceptible dip, and this is exactly the same manner in which the passage is effected between the same groups at the Mountain House.

Lower down on the river the coal is succeeded by white marls and sands, with beds of calcareous grit, which weather to a bright red colour. Among these beds there occur a great profusion of fragments of silicified exogenous wood. This group, however, was better exhibited on Battle River, where they dip to north-east at a very low angle. The valley of that river above its elbow is about 14 feet deep, and exhibits in its banks phenomena somewhat like those at La Roche Percée. The strata consist of banded clays and orange-coloured splintery limestone, with one bed quite filled with fragments of silicified wood, of an ashy or black colour. Towards the upper part of the section the clays are filled with sandy concretions, in some of which I found a few beautifully preserved fossils, the principal of which were a small *avicula*, a *cardium*, and other littoral shells.

There is also a bed of nine inches in thickness, composed entirely of rolled fragments of a species of *ostrea*, cemented together by coarse sand. This bed I detected at several points along the valley, and by using it as a test found that the whole group had a gentle inclination to north-east. At the point where we crossed Battle River a second time, in lat. $52^{\circ} 28' N.$, long. $111^{\circ} 30' W.$, in the bed of the stream, and at the foot of the section described above, the first coal met with in our progress westward was observed. Whether this be the same coal, however, as that on Red Deer River and at Edmonton, or a thin bed, such as was observed at La Roche Percée, and of quite a different age, I was unable to determine. If the former, then it is certainly overlaid by the *ostrea* and *avicula* beds; and these fossils when compared at home will throw much light on the true age of this coal. (I regret to say, that owing to the bursting of the hoops of the kegs in which they were packed for carriage to Edmonton from the Bow Fort, some of these fossils, as well as others, were lost on the road; but I hope yet to have an opportunity of procuring another set.)

This group of strata, characterized by the light-coloured marls which were found in Battle and Red Deer Rivers, was not observed along the north branch. The distance between the two points where they were found on the former rivers was 50 miles in a line due west.

The superficial strata which compose the prairie country preserve their horizontal character, as the Rocky Mountains are approached, until within 40 miles of the eastern limits of the true chain. At this distance they commence to undulate, at first gently, but soon assuming most intricate plications. The section along the Little Red Deer River displays the structure of the near range, which is wholly made up of the plications of the more superficial strata. The grits and clays of the Snake Portage again re-appear in this section, and are seen not only to change from their almost horizontal arrangement, but also to lose their original mineral character, the clays becoming indurated and converted into hard shales with a smooth soapy streak, while the sandstone beds are cleared in their original lines of false bedding, and rendered so very much harder, that in the summer when I observed isolated sections I was not sure of their identity, and only removed my doubts this winter by an examination of the continuous section afforded by Little Red Deer River.

From under this group the septaria clays arise, also much altered, in character, but I obtained fragments of the same fossils that were found at Fort Pitt, and the elbow of the south branch of the Saskatchewan, so that I have no doubt of their identity. They are found on the west side of the outer range in the valley which intervenes between it and the main chain.

The Rocky Mountains, as far as the west side of the watershed, consist of parallel ranges running from N.N.W. to S.S.E. between the north branch and

Bow River, but south of that changing to nearly north and south. These ranges are in groups, divided from one another by trough-like valleys traversing the length of the chain. The two eastern ranges from the Bow Fort to the Sawback range are mainly composed of a blue limestone, sometimes cherty, sometimes compact, and sometimes crystalline, with fossils which belong either to the Carboniferous or Devonian epoch. As a rule, these strata dip to the west; the same beds are, however, exhibited again and again, being thrown up in plications of great magnitude. Behind the Bow Fort, the mountains rise as huge cliffs made up of the cut-edges of these strata, elevated to the height of 3000 feet. Borne up on these limestones is a mass of strata composed of micaceous sandstone, with particles of carbon disseminated. This group also appears along Bow River and Deadman River, after they leave the mountains. Along with these sandstones are intercalated carbonaceous shales, among which are to be found traces of coal and carboniferous plants, of which latter one was a calamite, somewhat like *Calamites cannaformis* of the coal measures at home.

Resting on the flanks of the limestone ranges are patches of the septaria clays and grits, which are recognised at a distance by their earthy appearance. Such patches are found throughout the mountains at different points. Thus at the Vermilion River, the beds which, by their decomposition, give rise to enormous quantities of ochre along the courses of the smaller stream, seem to belong to this group. At the angle which this river makes, about fourteen miles from its source, there is a small patch of about one square mile in extent which presents an unmixed soil of ochre of a light reddish yellow colour, without a trace of vegetation on its surface.

To the west of the Sawback range the limestone was not observed, that range being composed of its bed cropping out vertically along the east side of a valley, in which stands Castle Mount, composed of horizontal beds of a hard quartzose sandstone, passing into a conglomerate, and capped by brown slaty shale. At the Kutanie plain, on the north branch of the Saskatchewan, this shale is seen to underlie the limestone.

The mountains which compose the height of land of the Vermilion Pass consist of the same rocks as the Castle Mount, but in descending Vermilion River a white slate is met with, which again is succeeded by a deep blue compact limestone, associated with a clay schist, curiously banded with red layers. On the north branch of the Saskatchewan, the mountains at its source are composed of this blue limestone and banded schist.

The very complicated relations of these strata render it impossible to form any sound view regarding their thickness or relative positions from data collected during one rapid survey, especially when it is remembered that they compose one of the most massive mountain chains in the world, the topography of which had to be learned step by step as the survey was made.

The most singular fact is, that no trace of the eruptive rocks which have caused the great convulsive movements of this portion of the earth's crust should be found in connexion with the dividing line of the mountains, from which the waters are thrown into the Gulf of Mexico, Hudson Bay, the Arctic and Pacific Oceans. The direction of these waters seems altogether to be determined by the arrangement of the superficial deposit filling up the valleys. Towards the lower part of the Vermilion River, the schists are fractured by slaty cleavage, but which is not very perfect. More to the south, however, from Mr. Sullivan's notes, I find that the mountains along the east side of the Kutanie river valley are composed of true clay slate, which also forms those at both heights of land crossed by Captain Palliser's party.

Captain JOHN PALLISER,
&c. &c.

I have, &c.,
(Signed) JAMES HECTOR, M.D.